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ABSTRACT

The influence of parents and other important adults on adolescent substance use is becoming recognized as a salient topic of research. A study designed to assess the impact of adult substance use on adolescents' progression through increasingly more advanced stages of substance use is reported here. Latent Transition Analysis was used to estimate the probabilities, conditional on exposure to adult substance use, of adolescents' (N=5,242) belonging to one of nine progressively more advanced stages of adolescent substance use. The probabilities of adolescents moving from one stage in the onset process to another, again, conditional on adult substance use, were also estimated. Results suggest that substance use by adults is a potent risk factor for adolescent substance use experimentation. Adolescents who reported exposure to adult use of alcohol, tobacco, or marijuana are more likely to be further advanced in the onset process at each of the junior high school years, grades 7 through 9. Findings regarding exposure to adult use of marijuana were most pronounced. It was not known whether the increased risk was due to modeling of substance use behavior, ineffective parenting due to substance use, the availability of substances, or a genetic predisposition toward substance use. (RJM)

Exposure to Adult Substance Use as a Risk Factor in Adolescent Substance Use Onset: Part I

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Abstract

This report outlines a study designed to assess the impact of exposure to adult substance use on adolescents' progression through increasingly more advanced stages of substance use. Latent Transition Analysis was used to estimate the probabilities of adolescents' belonging to each of nine progressively more advanced stages of adolescent substance use conditional on exposure to adult substance use at each of three times of measurement. Additionally, the probabilities of adolescents moving from one stage in the onset process to another were estimated, conditional on adult substance use. The results show that adolescents reporting exposure to adult use of alcohol, tobacco, or marijuana are more likely to be further advanced in the onset process at each of the junior high school years, grades 7 through 9. The results for exposure to adult use of marijuana are most pronounced.

Exposure to Adult Substance Use as a Risk Factor in Adolescent Substance Use Onset

The influence of parents and other important adults on adolescent substance use is becoming increasingly recognized as a salient topic of research and intervention (Harken, 1987). Parental use of substances has been shown to be an important predictor of adolescent substance use (Hawkins, Catalano, & Miller, 1992), stronger than parents' attitudes toward adolescent drug use (Kandel et al., 1978). An association between parental and adolescent substance use has been found in relation to drinking behaviors (Kandel, 1978; Peterson et al., 1994; Zucker, 1976), tobacco use (Chassin et al., 1981; Krosnick & Judd, 1982), the use of illicit drugs (Kandel, 1978), and for substance use in general (Johnson et al., 1990; Kandel, Kessler & Margulies, 1978). However, little is known about the nature of parental influence on the *initiation* of drug use and subsequent *rates of progression* through increasingly more advanced stages of substance use.

Most studies of adolescent substance use are constrained by the type of questions that can be asked, given the concerns of schools and parents who seek to protect the adolescents' privacy, and accuracy of responses given by the adolescents, who may misrepresent his or her position deliberately or who may simply may misunderstand the question or be careless in responding. For instance, it may be difficult for a junior high school student, especially those in the earlier years of junior high, to recognize the state of drunkenness in him or herself or in others. There may be a considerable amount of error, especially, in reporting the substance use behaviors of

parents and other important adults. It is essential, then, that studies of this sort seek to partial out as much of this error variance as possible.

In order to examine whether exposure to adult substance use is a risk factor for adolescent substance use onset, an appropriate model of the adolescent onset process is required. In a previous study, Collins, Graham, Long, and Hansen (1994) compared the fit of five different models of onset, selected to reflect sequences of drug use behaviors identified in the literature. The most complex of the models (Figure 1)

1: No Use
2: Alcohol Experimentation
3: Tobacco Experimentation
4: Alcohol & Tobacco Experimentation
5: Alcohol Experimentation & Drunkenness
6: Alcohol Experimentation, Drunkenness & Advanced Use
7: Alcohol & Tobacco Experimentation & Drunkenness
8: Alcohol & Tobacco Experimentation & Advanced Use
9: Alcohol & Tobacco Experimentation, Drunkenness & Advanced Use

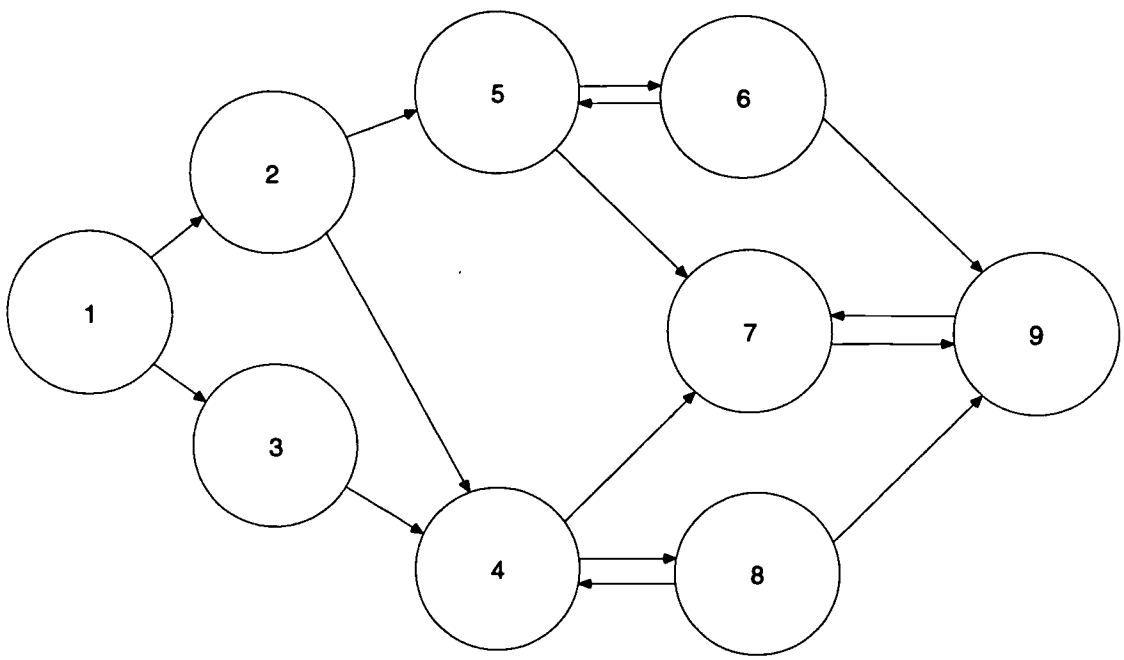


Figure 1: Alternative Adolescent Onset Model 5 (Collins, Graham, Long & Hansen, 1994).

contains nine latent statuses, indicated by combinations of responses to four variables: experimentation with alcohol, experimentation with tobacco, experience of drunkenness, and a composite variable reflecting recent tobacco use, recent alcohol use or lifetime marijuana use (Appendix A). It should be noted that, due to the wording of the advanced use item, it was possible for an adolescent to move from an advanced use status at one time to reporting no advanced use at a subsequent time if the adolescent had not recently used alcohol or tobacco.

According to this model, an adolescent begins the onset process in a drug-free latent status (latent status 1). From this initial status, an adolescent might progress to experimentation with either alcohol only (latent status 2) or tobacco only (latent status 3). Each of these two latent statuses might lead to experimentation with both alcohol and tobacco (latent status 4). From here, it is possible for the adolescent to experience drunkenness (latent status 7) or engage in an advanced use behavior without drunkenness (latent status 8). Alternatively, if an adolescent had tried alcohol only, he or she might experiment with alcohol to the point of drunkenness (latent status 5). This status might lead to the addition of an advanced use behavior (latent status 6) or to experimentation with tobacco (latent status 7). Each route from the initiation of substance use may lead to the most advanced latent status, which is characterized by experimentation with tobacco and with alcohol to the point of drunkenness, as well as an advanced substance use behavior (latent status 9).

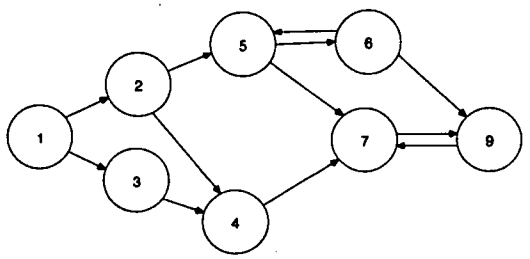
The remaining four models reflect variations in this sequence only among the more advanced stages of the model. Model 1 omits both the 6th and the 8th statuses; model 2 omits the 7th status; model 3 omits the 8th status; and model 4 omits the 6th

status (Figure 2). Based on the G-squared values for both the model-fitting and the crossvalidation analyses, the authors concluded that model 2 was the best-fitting model of adolescent substance use onset for both males and females.

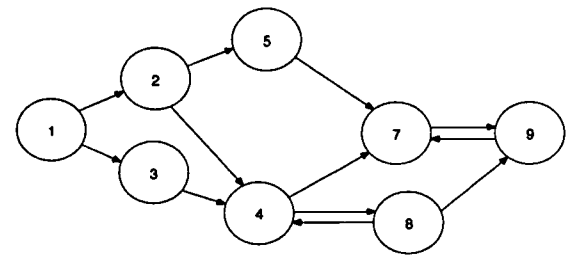
In the present study, we fit these five models to a different random sample of the same data that were used by Collins et al. (1994). Then, using the best-fitting model, we explore the impact of exposure to adult use on the process of adolescent substance use onset. Specifically, those adolescents exposed to adult substance use are expected to be at a greater risk regarding the timing of initiation and rate of progression through the substance use onset process than are those adolescents not exposed to adult substance use. Both the probabilities of belonging to more advanced stages of drug use at any given time and the risk of making transitions toward more advanced stages between times are considered. Furthermore, we take a broad view of the influence of important adults in the lives of adolescents. In today's family, adults such as step-parents, live-in partners of parents, or grandparents may have as much influence as a child's parents, or even more in some cases. For this reason we investigated the influence of highly important and frequently seen adults rather than limiting our data to parents.

1: No Use
2: Alcohol Experimentation
3: Tobacco Experimentation
4: Alcohol & Tobacco Experimentation
5: Alcohol Experimentation & Drunkenness
6: Alcohol Experimentation, Drunkenness & Advanced Use
7: Alcohol & Tobacco Experimentation & Drunkenness
8: Alcohol & Tobacco Experimentation & Advanced Use
9: Alcohol & Tobacco Experimentation, Drunkenness & Advanced Use

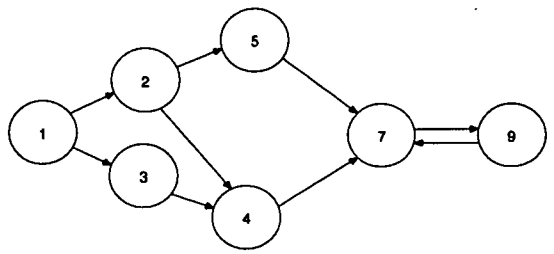
Model 1



Model 2



Model 3



Model 4

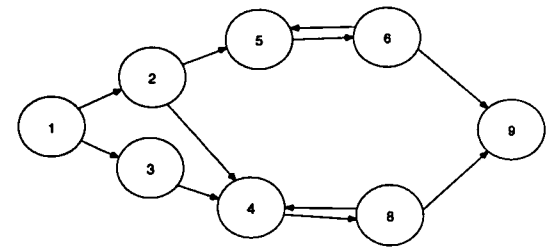


Figure 2: Alternative Adolescent Onset Models 1-4 (Collins, Graham, Long & Hansen, 1994).

Methods

Subjects

A subset of 5,242 adolescents who participated in the Adolescent Alcohol Prevention Trial (AAPT; Graham et al., 1989; Hansen & Graham, 1991; Hansen et al., 1988) were used for this study. The original sample was characterized by an approximately equal representation of males and females, and had a mixed ethnic composition. The AAPT adolescents attended school in four California school districts, including both public schools and private Catholic schools. None were inner-city schools. One panel of subjects was assessed annually for six years (from the 5th to the 10th grade) and another was assessed annually for four years (from the 7th to the 10th grade). The remaining two panels were assessed for five years (from the 5th to the 9th grade and from the 7th to the 9th grade). Data collection began in 1986 and ended in 1992.

The subset of the AAPT subjects selected for inclusion in this study were those who had been in the 7th grade at the initial assessment and who were then assessed at the 8th and 9th grades. This included two of the four panels. These panels began involvement in the study in 1987 and in 1988.

Measures

Ten items were taken from the AAPT questionnaire. These items are described below and the original items are reproduced in Appendix A.

Latent status indicators. Four indicators were used to identify the nine stages of adolescent substance use. **Experimentation with tobacco** was operationalized by an

item assessing adolescents' lifetime use of cigarettes. The adolescents' responses were dichotomized to reflect those who had never smoked (number of cigarettes smoked in their lifetime: "none") and those who reported ever smoking (number of cigarettes smoked in their lifetime: "only one puff" to "more than 5 packs"). Similarly, **experimentation with alcohol** was measured by an item reflecting lifetime use of alcohol and was dichotomized into nonusers (number of drinks of alcohol in their lifetime: "none" or "only sips for religious purposes") and users (number of drinks of alcohol in their lifetime: "only sips -- not for religious purposes" to "more than 100"). **Experience of drunkenness** was assessed using an item that asked the adolescents to report how many times they had ever been drunk. Again, this item was dichotomized to reflect no experience of drunkenness (number of times drunk:"never") and at least one experience of drunkenness (number of times drunk:"only once" to "more than 20 times").

The fourth indicator, **advanced use**, was created by combining three items: 1) recent use of tobacco or 2) of alcohol (within one month previous to the assessment) or 3) any use of marijuana. The item reflecting recent tobacco use was dichotomized to reflect those adolescents who had not recently smoked cigarettes (number of cigarettes smoked in the past month:"none") and those who had recently smoked (number of cigarettes smoked in the past month:"only one puff" to "more than one pack"). Similarly, the item assessing recent use of alcohol was dichotomized to reflect those who had not recently used alcohol (number of drinks in the past month:"none" or "only sips for religious purposes") and those who had recently used (number of drinks in the

past month:"only sips -- not for religious purposes" to "more than 20"). The item measuring lifetime marijuana use was dichotomized to reflect those adolescents who had ever smoked marijuana (ever used marijuana:"yes") and those who had never used marijuana (ever used marijuana:"no"). An adolescent was considered an advanced user if he or she responded positively to any of these three items.

Latent class indicators. In addition to the indicators of adolescent substance use, exposure to adult substance use was assessed for each of three substances: tobacco, alcohol, and marijuana. Adolescents were asked to indicate how many of the two most important adults in their lives 1) smoke cigarettes, 2) drink alcohol about every day, and 3) ever smoke marijuana. The responses to these items were dichotomized to reflect no exposure to adult use and exposure to at least one adult's use of the substances. A fourth latent class indicator was created by summing the responses indicating adult substance use across the three substances. This resulted in four possible categories of risk: 1) no risk of adult exposure, 2) risk due to exposure to adult use of any one substance, 3) risk due to any two substances, and 4) risk due to all three of the substances assessed in this study.

Results

Latent Transition Analysis (LTA; Collins et al., 1994; Collins, Wugalter & Rousculp, 1992) was used to estimate the models of adolescent substance use onset. Once an appropriate model was fit, LTA was also used to fit the onset model within the context of latent classes of exposure to adult use. LTA is a statistical program which estimates the probabilities of membership in latent classes (categories of enduring subject characteristics), of membership in dynamic latent statuses (i.e., stages in a

developmental process) at each time of measurement, and of making transitions between latent statuses over time. A detailed description of the LTA software and underlying statistical model can be found in the LTA User's Guide[1].

Crossvalidation

In order to assess the stability of the model fit and the individual parameter estimates, double crossvalidation was used. In this procedure, the sample is divided into two equal subsamples. A model is fit to each subsample separately. Then, the fit of the parameter estimates based on each subsample is assessed on the opposite subsample. If the fit is good (the parameter estimates are similar across subsamples), the model crossvalidates well. Further, if a model crossvalidates well, one is better justified in generalizing the results to a larger population. In addition, the point estimates obtained from the two subsamples can give an indication of the variability of the parameter estimates. This will be a useful diagnostic tool, but should not be considered a true estimate of the standard error.[2]

In addition to the double crossvalidation procedure, within each subsample two very different sets of starting values were used to guard against solutions based on a local minimum in the likelihood function for the goodness of fit statistic (G-square). Reaching a local minimum can be a problem in cases where the model is not well identified (Collins et al., 1992). If substantially different model fit statistics result from

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[1]The LTA software and the LTA User's Guide can be obtained from Linda M. Collins, The Methodology Center, Penn State University, 159 South Henderson Bldg., University Park, PA 16802 or send a request to lmc8@psu.edu.

[2]Although not available in the current version of the LTA software (LTA 1.1), standard errors of the parameter estimates will be included in future versions of LTA.

the two sets of starting values, providing more stringent constraints may help to identify the model. This can be done in two ways; two or more parameters can be constrained to be equal to each other, or one or more parameters can be fixed to some specified value or values.

Imputation

A data imputation procedure was performed in order to avoid needlessly restricting the sample size and risking biases associated with inclusion of only those subjects who had complete data for each of the three times of measurement. This bias is particularly salient in studies concerning delinquency or problem behaviors (Graham, Hofer, & Picinnin, 1994). Using the EM algorithm (Dempster et al., 1977; Little and Rubin, 1987), a covariance matrix was computed for the raw data in both of the subsamples, using adolescents' reports of 7th grade school grades[3] as well as all of the items in the model to estimate the missing items. This covariance matrix was used to generate an imputed data matrix, where the originally missing values had been replaced by an estimate; otherwise, the data matrix remained unaltered.

Response Pattern Format

Data used for submission to the LTA program must be in response pattern format, where observed response pattems and their sample proportions, rather than individual students, comprise the unit of analysis. This is similar to submitting summary statistics (covariances and means) as input data matrices in LISREL. A sample SAS

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[3]Grades were expected to be related to the missingness of the items, because marginally involved students are more likely to be absent from school, where the assessments took place, and also to receive poorer grades. See Graham, Hofer, & Picinnin (1994) for a discussion of this issue in the context of prevention research.

program illustrating the commands used to convert raw data into response pattern data is given in Appendix B.

Model Selection

Initially, the five models outlined in Collins et al. (1994) were fit to only those cases with complete data (4,390 of the 5,242 subjects). Comparison of these models revealed that the most inclusive model (Figure 3), characterized by all nine of the latent statuses described above, best fit the data (i.e., yielded

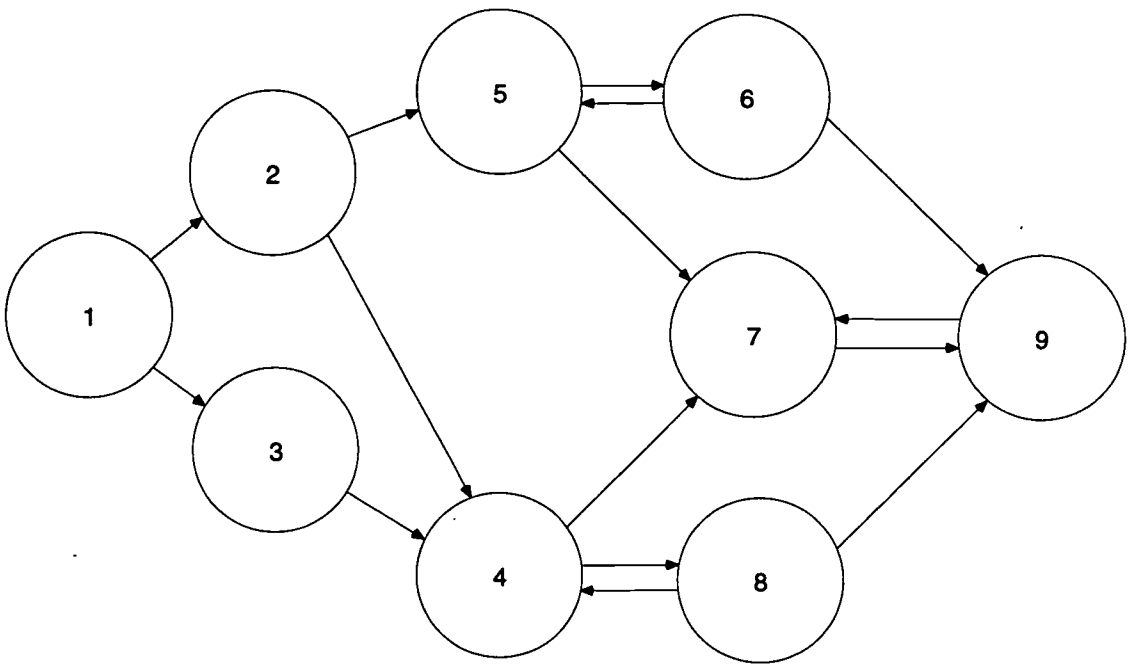

Figure 3: Best fitting of the alternative adolescent onset models (Collins, Graham, Long & Hansen, 1994).

the lowest crossvalidation G-squared values[4]: refer to Appendix C). This model fit best for the 7th to 8th grade transition, the 8th to 9th grade transition, and for transitions over all three grades. This sequence of statuses was used throughout the remainder of the study. In addition to the first order models, second order models were fit, using two separate datasets, the dataset containing only complete cases and the imputed dataset (see Appendix D for the resulting model fits). Second order solutions did not provide a significantly improved fit over the first order models. Furthermore, the imputed solutions were superior to the solutions obtained with listwise deletion, after differences in sample size are taken into account. Therefore, the first-order solution resulting from the imputed data was retained for further refinement.

Having selected a model of adolescent onset, we then added a latent class variable reflecting exposure to adult substance use. Using a model with exposure to adult drunkenness as a latent class, we found that the model required constraints in order to reach an acceptable level of identification. The model became sufficiently well-identified (i.e., the goodness of fit statistics obtained from the two sets of starting values converged to a similar value) after the probabilities of giving a misleading response were constrained to be equal across all four latent status indicators and across the two latent classes. In addition, the taus corresponding to "illegal" transitions (i.e., those not allowable given our model) were set to zero.

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[4]Crossvalidation G-squared values are not associated with degrees of freedom, since there are no parameters to be estimated. Therefore, these G-squared values can be directly compared across models with differing numbers of parameters.

After refining the model in this way, a second order model was again tried. Still, the second order solution did not significantly improve the fit of the model[5]. Appendix E contains a table of the model fit statistics for each of these alternative models. Appendix F shows an example of the constraints and one set of starting values used in this type of latent class model.

The goodness of fit statistics for each of the models of exposure to adult substance use, namely, the models testing exposure to adult tobacco use, adult alcohol use, adult marijuana use, and categories of exposure risks, can be found in Appendix G. Each model fit the data well (i.e., yielded G-squared values that are small compared to the associated degrees of freedom), yielded consistently low cross-validation G-squared values, and showed good parameter stability across samples.

In the following sections, parameter estimates associated with each of the four models will be discussed. First, the parameters reflecting the degree of error contained in the latent class and latent status variables (rho parameters) will be discussed. Second, the proportions of adolescents expected to belong to each of the latent classes in each model (gamma parameters) will be presented. Then the proportions of each latent class belonging to each latent status at each of the three times of measurement (delta parameters) will be discussed. Finally, the proportions of those within each latent class and latent status condition at one time transitioning to each of the latent statuses

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[5]However, recent research on constraints in LTA suggests that there may have been a problem with how the constraints were specified in the tau matrix, leading to a solution that may not have been a true maximum likelihood solution.

by the next time (tau parameters) will be presented for each of the two transition periods.

Exposure to Adult Alcohol Use

Rho parameters. The rho parameters associated with the exposure to adult alcohol use indicator are either 0.0 or 1.0, indicating an error-free relationship between the reported adult exposure and the expected exposure. Because the model does not constrain the estimation of the latent class memberships (i.e., each possible obtained value is a legal value according to the model), the data could be fit to the latent class memberships perfectly.

This is not the case for the rho parameters associated with the latent statuses, however. The latent status response patterns contain discrepancies according to the models chosen. For instance, absent from the onset model is a latent status characterized by drunkenness but no experimentation with alcohol. Our model requires that experience of drunkenness is preceded by experimentation with alcohol and cannot occur without this experimentation. However, it is possible for an adolescent to indicate experimentation with drunkenness but no prior experimentation with alcohol. This would clearly be an error in the adolescent's response. The rho parameters reflect this type of error.

A less obvious example is the case where an adolescent indicates an advanced use behavior but no prior experimentation behaviors. This type of a pattern of onset is feasible, but our model requires that experimentation precedes advanced use. A pattern of onset characterized by experience with marijuana, for example, but no prior experimentation with alcohol or tobacco would be at odds with the specified model.

This type of discrepancy between the model and the data is also contained in the rho parameters.

The rho parameters of the latent status indicators were quite high for both subsample model solutions, ranging from .937 to .939 (where an error-free model would yield 1.00) for the tobacco experimentation item, from .934 to .940 for the alcohol experimentation item, from .951 to .952 for the drunkenness item, and from .889 to .892 for the advanced use composite.

Gamma parameters. Estimates of the proportion of adolescents expected to have been exposed to adult alcohol use are very similar across the two subsamples, ranging from .275 to .276.

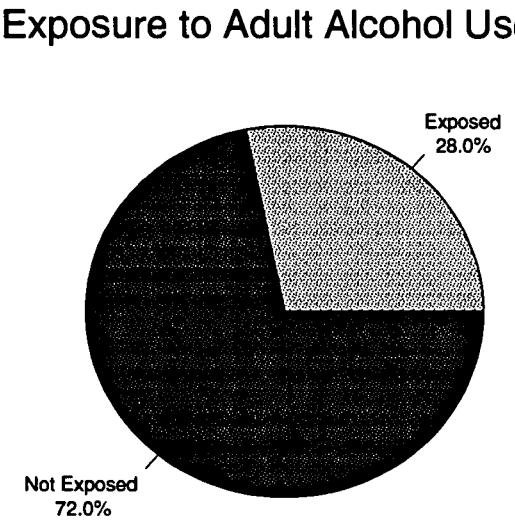

Figure 3: Proportion of Adolescents in Each Latent Class.

Delta parameters. Appendix H contains the delta parameter estimates resulting from the exposure to adult alcohol use model. Generally, it can be seen that as time

goes on, fewer adolescents are remaining drug-free and a greater number are entering more advanced stages of the onset process as they proceed through the junior high school years.

These estimates differ by latent class membership. Those exposed to adult alcohol use are at greater risk for belonging to later stages in the onset process and less likely to be in the earlier stages than are their nonexposed counterparts. These patterns of risk are evident at each time of measurement. For instance, about 65 percent of the adolescents *not* exposed to adult alcohol use had never tried drugs or had only experimented with alcohol in 7th grade, as compared to 46 percent of the adolescents exposed to adult alcohol use. By 9th grade, about 37 percent of the unexposed adolescents still remained in these initial stages of the onset process, as compared to only about 24 percent of the exposed adolescents.

However, there seems to be no greater risk for *accelerated* onset for adolescents exposed to adult alcohol use. In other words, the relative proportion of exposed and unexposed adolescents in each status does not seem to increase over time. This suggests that exposure to adult alcohol use increases the risk of initiating the onset process earlier. Figures 5 and 6 show the relative risk for each group of adolescents of being in the initial, drug-free stage of the onset process and the most advanced stage of the onset process, respectively, for each of the three times of measurement.

It is important to note that several latent statuses have a low probability of occurence in the sample and, therefore, the stability of the tau parameter estimates

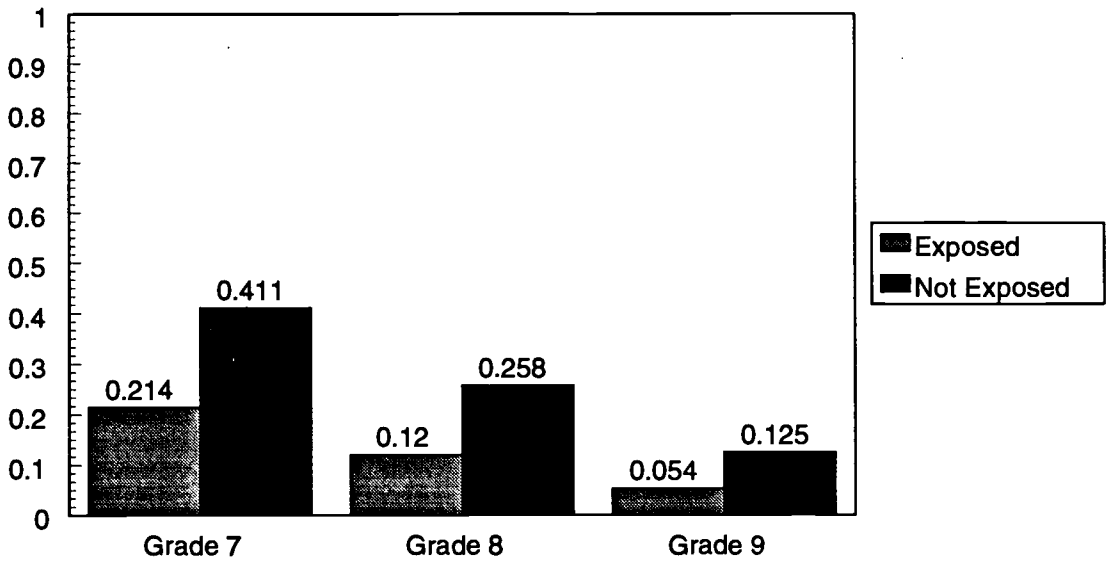

Figure 5: Proportion of each adult alcohol use exposure group expected to belong to the drug-free status at each time of measurement.

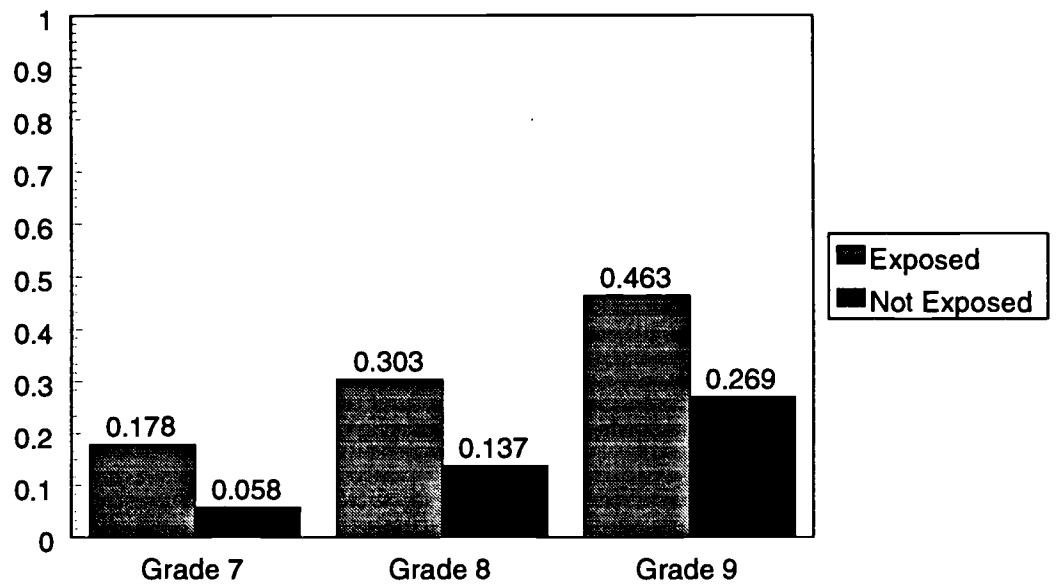

Figure 6: Proportion of each adult alcohol use exposure group expected to belong to the most advanced status at each time of measurement.

associated with these statuses will be affected. These include the status characterized by experimentation with tobacco only (latent status 3), the status characterized by experimentation with alcohol and experience of drunkenness (latent status 5), the status characterized by experimentation with tobacco, experimentation with alcohol, and experience of drunkenness (latent status 7), and the status characterized by experimentation with alcohol, experience of drunkenness, and an advanced use behavior (latent status 6).

Tau parameters. Because latent statuses 3, 5, 6, and 7 are represented poorly in the sample and often cause widely variable tau estimates, the following discussion will focus on the remaining latent statuses. Values given are averages of the two crossvalidation subsample estimates. Appendix I contains all of the tau parameter estimates obtained for the two subsamples.

Tau estimates generally do not differ substantially for the exposed and unexposed groups of adolescents. For this model, then, the taus can be reported as general trends for adolescent substance use onset, regardless of the adult alcohol use exposure status of the adolescent. Adolescents in the no use latent status in 7th grade are likely to remain in this status (about 55%) or to try alcohol (about 23%). Those who have tried alcohol are most likely to remain in this status (about 70%). Those who have tried alcohol and tobacco either remain in this status (about 50%), use alcohol or tobacco frequently or try marijuana (25%) or progress to the most advanced status in the model (about 20%). Those who have tried both alcohol and tobacco and who can be considered an advanced user are likely to either remain in this status (about 48% at

the first transition and about 40% at the second), discontinue the advanced use behavior (about 15%), or progress to the most advanced stage (about 33% at the first transition and about 47% at the second). Finally, those in the most advanced use status are likely to remain there (almost 100%) rather than discontinue the advanced use behavior.

Exposure to Adult Tobacco Use

Rho parameters. As with the adult alcohol use exposure model, the rho parameters associated with the exposure to adult tobacco use indicator were either 1.00 or 0.00, indicating an error-free relationship between the indicator and the latent class membership. The rhos associated with the latent status indicators, however, revealed a small amount of error. The estimates of the rho parameter associated with adolescent tobacco use item ranged from .938 to .940: the rho estimates for the alcohol use item ranged from .934 to .940; the rho estimates for the drunkenness item were .952 for both subsamples; and the estimates for the advanced use composite ranged from .888 to .891.

Gamma parameters. The estimates for the gamma parameters were very similar across the two subsamples. The estimated proportion of adolescents exposed to adult tobacco use ranged from .519 to .522 (Figure 7).

Exposure to Adult Tobacco Use

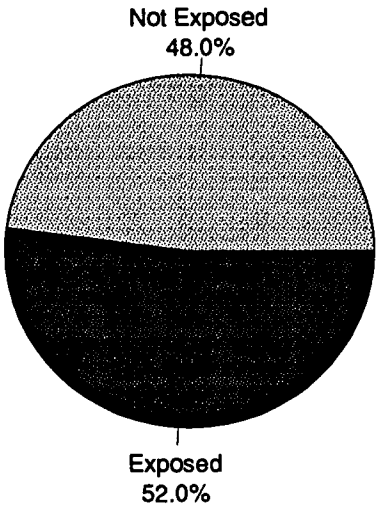

Figure 7: Proportion of adolescents in each latent class.

Delta parameters. As with the model of exposure to adult alcohol use, the delta parameters for this model (see Appendix J) show that exposure to adult tobacco use is related to a greater probability of being in more advanced stages of the onset model. Again, relatively few adolescents belonged to latent statuses three, five, six and seven according to this model.

An examination of the memberships in the first and final stages of the onset process shows that exposure to adult tobacco use is indeed a risk factor in adolescent substance use (Figures 8 & 9). More of the unexposed adolescents than adolescents who had been exposed to adult tobacco use belonged to the drug-free status at any of the three times and comparatively fewer belonged to the most advanced status at each time. The differences between the adolescents who have not been exposed to adult

Exposure to Adult Tobacco Use

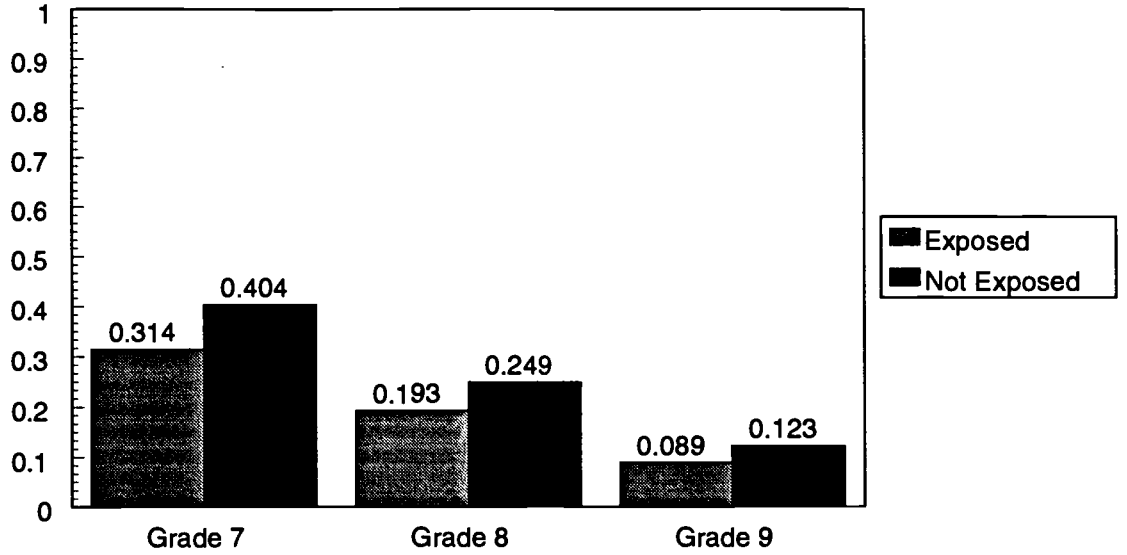

Figure 8: Proportion of each adult tobacco use exposure group expected to belong to the drug-free status at each time of measurement.

Exposure to Adult Tobacco Use

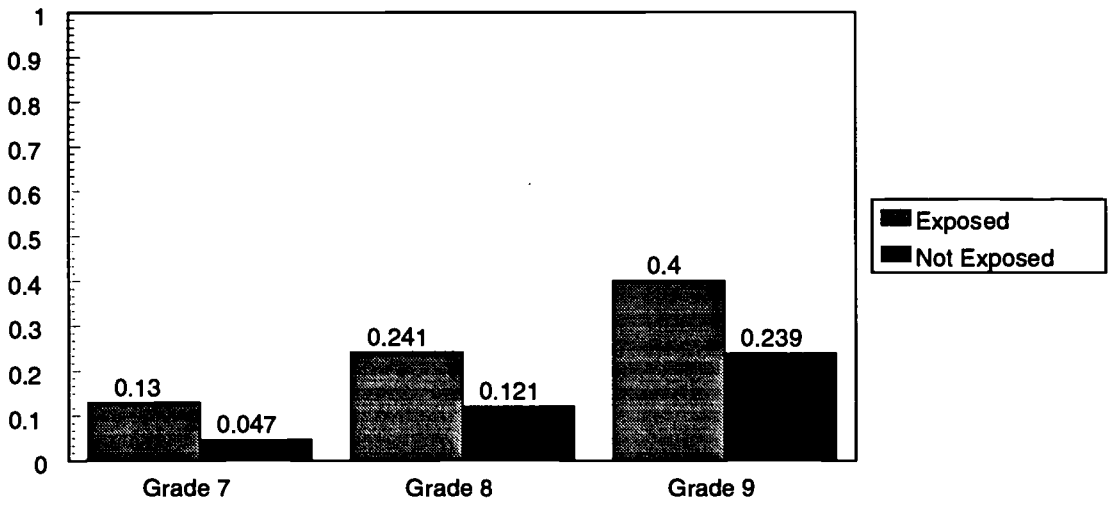

Figure 9: Proportion of each adult tobacco use exposure group expected to belong to the most advanced status at each time of measurement.

tobacco use and those who have is not as large as is the difference between adolescents who have not been exposed to adult tobacco use and those who have.

Tau parameters. The overall pattern of typical transitions in the model of exposure to adult tobacco use is similar to that for the model of exposure to adult alcohol use (see Appendix K). However, adult tobacco use may, in some cases, influence the *rate* at which adolescents progress from one stage to the next. Comparison of the tau estimates for the second transition suggests that some older adolescents exposed to adult tobacco use may advance more quickly than do those not exposed to this risk factor. In particular, exposed adolescents who belong to the drug-free latent status in 8th grade are more likely than their counterparts to advance to the latent status characterized by experimentation with tobacco and alcohol by 9th grade (about 15% versus about 5%). Adolescents exposed to adult tobacco use who belong to the alcohol experimentation stage in 8th grade are less likely to remain in this status in 9th grade (about 58% versus about 71%) and more likely than their unexposed peers to progress to the most advanced stage of the onset process (about 10% versus about 5%). Exposed adolescents who belong to the status characterized by experimentation with tobacco and alcohol in 8th grade are less likely to remain in this status in 9th grade (about 42% versus about 51%) and more likely to progress to the most advanced stage in the model by 9th grade (about 30% versus about 19%).

Exposure to Adult Marijuana Use

Rho parameters. The rho parameters associated with the indicator of exposure to adult marijuana use yielded error-free estimates (0.00 and 1.00). The rho parameters associated with the latent status indicators revealed an acceptable degree

of error. The two subsamples yielded rho estimates for the adolescent tobacco use item that range from .939 to .940; for the alcohol use item, the rho estimates are .934 and .940; for the drunkenness item, they are .951 and .952; and the rho estimates for the advanced use composite are both .889.

Gamma parameters. The model of exposure to adult marijuana use indicates that approximately 11% of the sample was exposed to adult use (separate subsample estimates were 10.6% and 11.2%) (Figure 10).

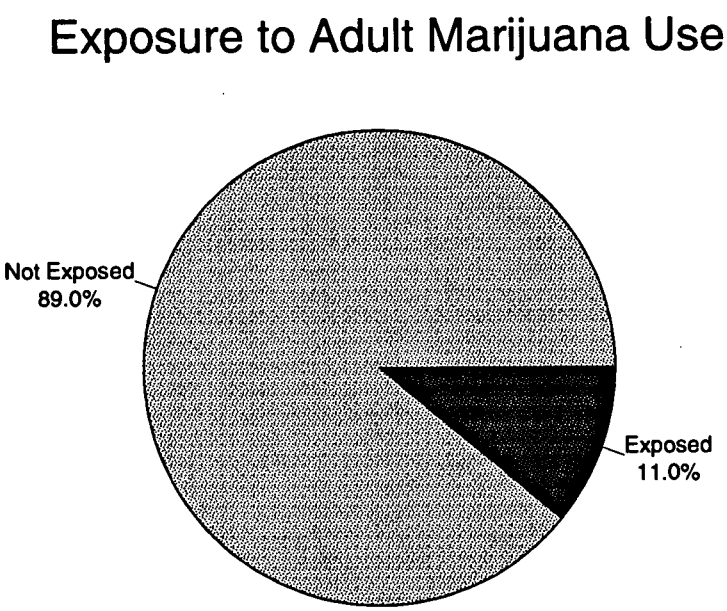

Figure 10: Proportion of Adolescents in Each Latent Class.

Delta parameters. Because a relatively small percentage of the sample is estimated to have been exposed to adult marijuana use, the estimates for the delta parameters for exposed adolescents vary, sometimes substantially, across subsamples (refer to Appendix L). In addition, as in the previous two models, latent statuses three, five, six and seven have a low probability of occurrence for either group of adolescents at any of

the three time points. In this model, latent status four (experimentation with both alcohol and tobacco) has a low probability of occurrence, as well, for adolescents exposed to adult marijuana use. However, the proportions of each exposure group in the first and final stages of the onset process are quite revealing. Figures 11 and 12 show that the adolescents who were not exposed to adult use of marijuana had a considerably higher probability of being in the drug-free latent status, and a considerably lower probability of being in the most advanced latent status, as opposed to the exposed group.

Tau parameters. The estimates for the tau parameters in this model vary widely between the two subsamples, particularly for those transitions involving low-probability latent statuses (refer to Appendix M). Still, the pattern of progression was very similar to what was found in the previous two models. Tentatively, it can be said that adolescents who have been exposed to adult marijuana use are less likely to remain in the drug-free status during the first transition (about 47% versus about 62%). Of those adolescents who had tried alcohol only in the 8th grade, fewer of those who have been exposed to adult marijuana use can be expected to remain in this status in 9th grade than can those not exposed to this adult influence (about 50% versus about 67%). In addition, there is some indication that, having experimented with alcohol, those exposed to adult marijuana use are more likely to progress to experimentation with tobacco, and frequent use of alcohol or tobacco or experimentation with marijuana, although these estimates vary widely (about 18% versus about 7%).

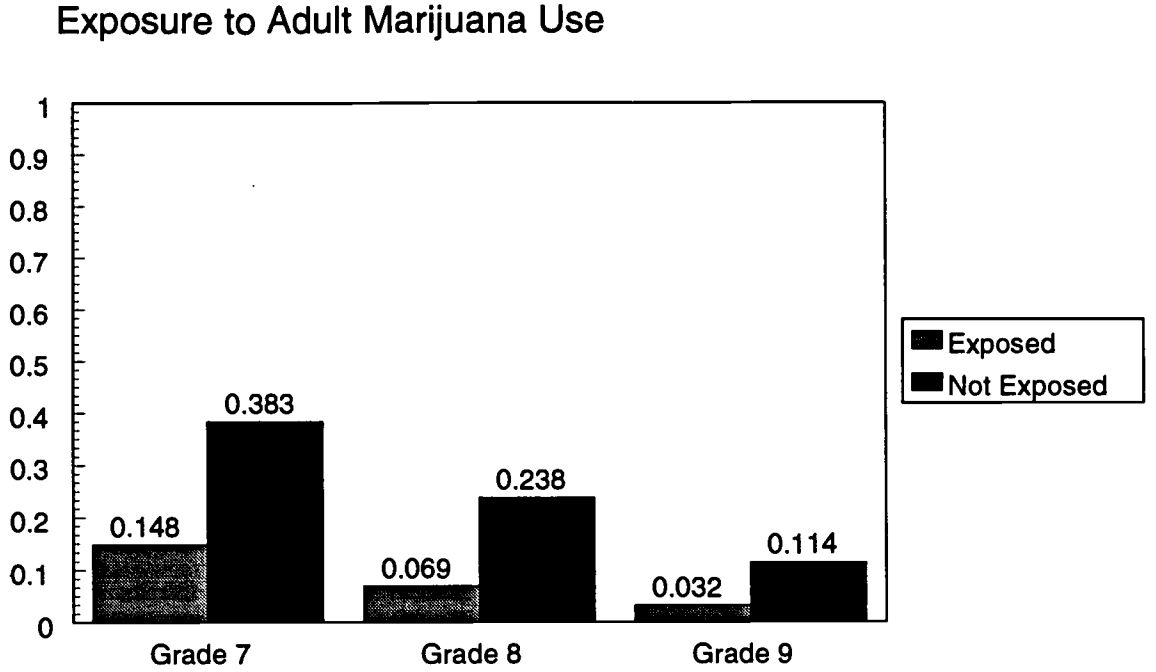

Figure 11: Proportion of each adult marijuana use exposure group expected to belong to the drug-free status at each time of measurement.

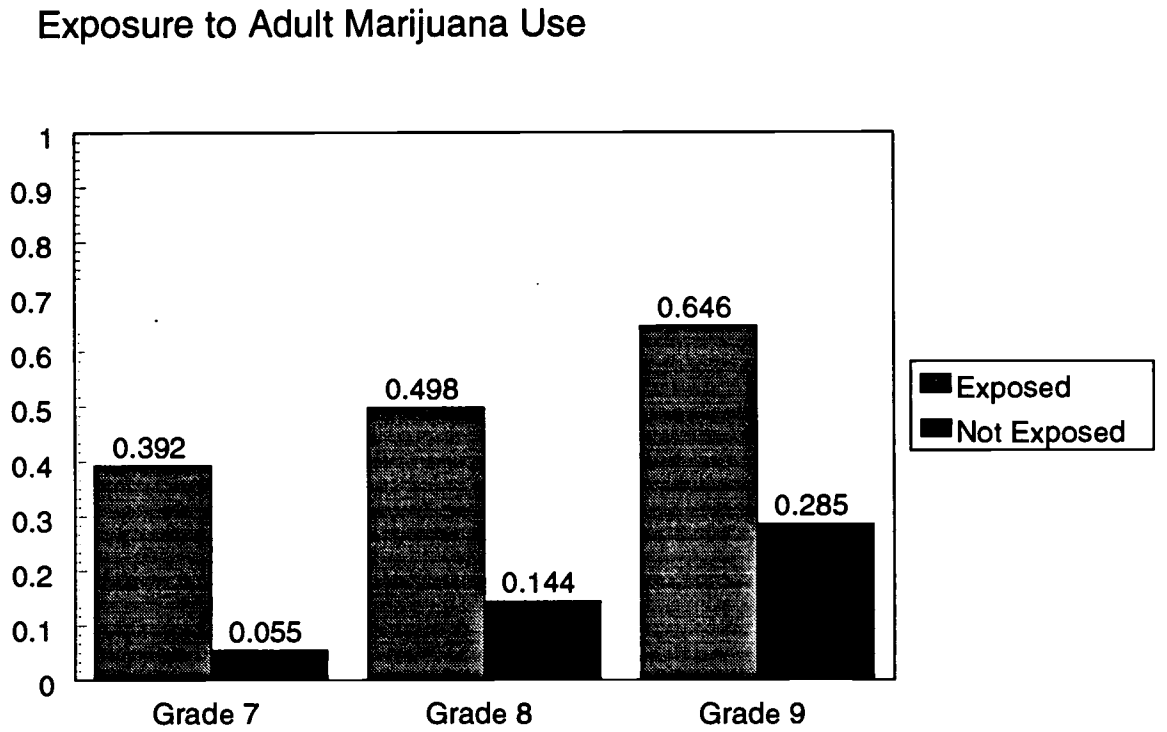

Figure 12: Proportion of each adult marijuana use exposure group expected to belong to the most advanced status at each time of measurement.

Risk Categories of Exposure to Adult Substance Use

Rho parameters. The rho parameter associated with the indicator reflecting the four categories of risk (exposure to adult use of none, any one, any two or all three of the substances) showed the indicator to be error-free. The rho parameters associated with the latent statuses were as follows: rho estimates for the adolescent tobacco use item range from .938 to .941; estimates associated with the adolescent alcohol use item range from .934 to .940; rhos for the drunkenness item are both .952; and the rhos for the advanced use composite range from .890 to .894.

Gamma parameters. Gamma estimates range from .362 to .363 for adolescents expected to have been exposed to adult use of none of the substances. The proportion expected to have been exposed to adult use of any one substance ranged from .407 to .412. The proportion of adolescents expected to have been exposed to adult use of any two of the substances ranged from .180 to .186. Finally, the expected proportion to have been exposed to all three of the substances assessed in this study ranged from .044 to .046. Clearly, few adolescents belong to the most at risk category and therefore, parameter estimates based on this category can be expected to vary substantially (Figure 13).

Delta parameters. Similar results were found concerning the delta parameters of this model as were found in the previous models (refer to Appendix N). Specifically, the delta parameters show that the exposure categories present an increased risk of earlier initiation of the substance use onset process and an increased risk of belonging to the

most advanced stage in the process at any of the three years. Figures 14 and 15 illustrate that the increase in risk corresponds to the increase in exposure, with the adolescents who are exposed to all three substances at highest risk.

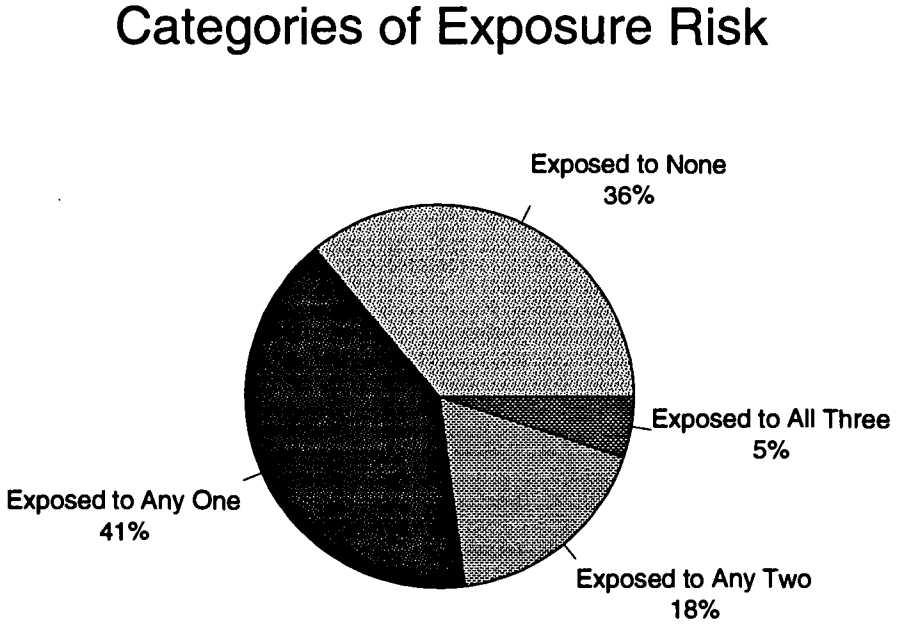

Figure 13: Proportion of adolescents belonging to each latent class.

It bears repeating that statuses three, five, six and seven are poorly represented in all of the risk categories and that status four is poorly represented in the riskiest category, as well. This suggests that adolescents exposed to adult use of three substances can be expected to be in the very early stages or the latest stages of the substance use onset process, spending little time in the intermediate stages.

Tau parameters. Since few adolescents are expected to have been exposed to adult use of all three of the substances in the model, discussion of the tau parameter estimates will be limited to the first three risk categories (refer to Appendix O). Still,

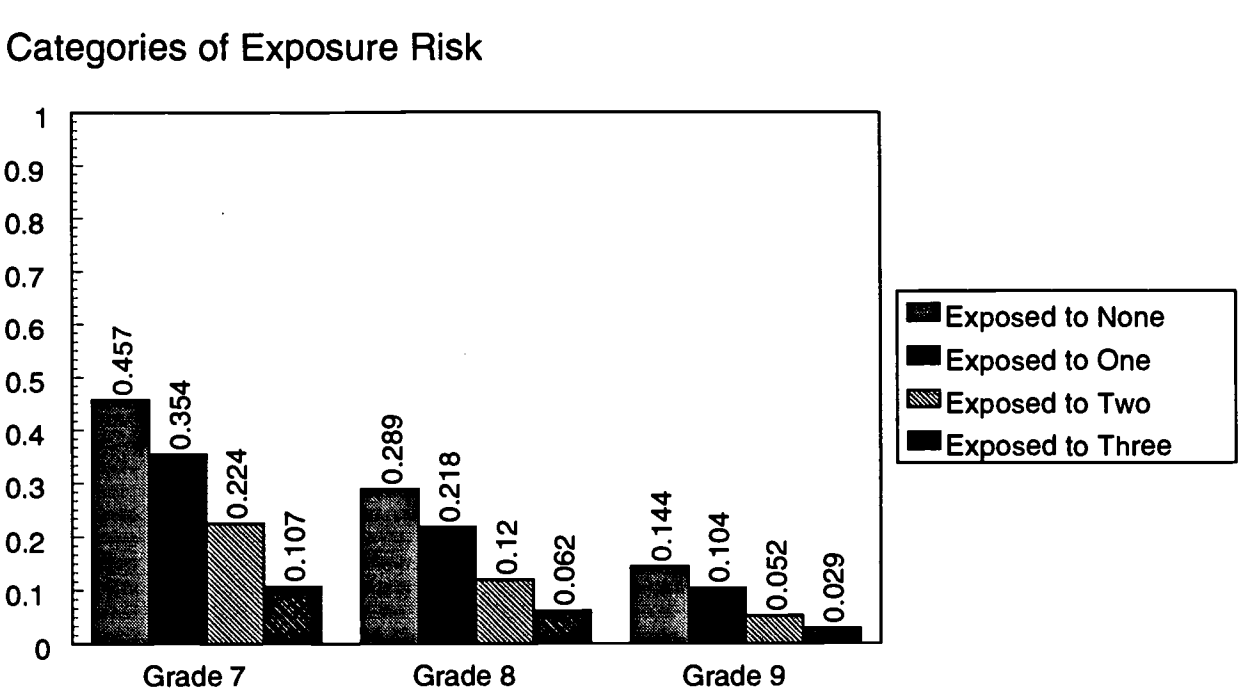

Figure 14: Proportion of each risk category expected to belong to the drug-free status at each time of measurement.

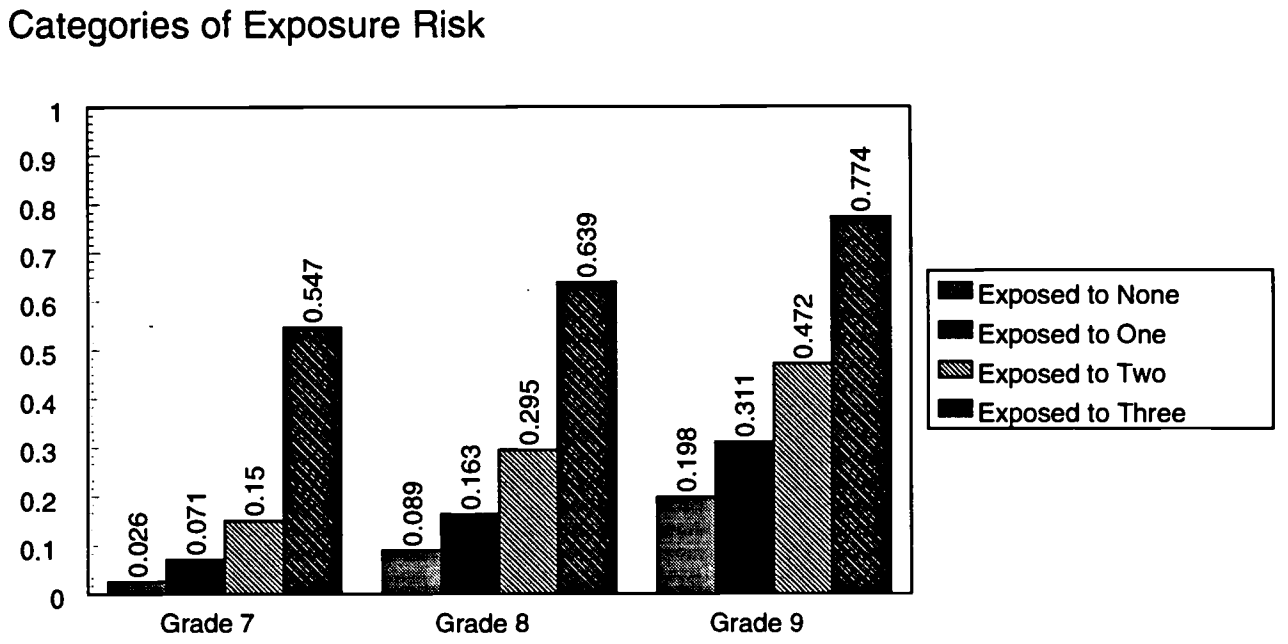

Figure 15: Proportion of each risk category expected to belong to the most advanced status at each time of measurement.

these remaining categories yielded estimates that are quite variable. Because of this, the results presented in the following discussion should be viewed with caution.

It appears that exposure to adult substance use affects the number of adolescents within each category that can be expected to remain drug-free. Adolescents who had been exposed to adult use of none or just one of the substances were more likely to remain drug-free during the first transition than were those exposed to adult use of any two of the substances (about 63% and 61% versus about 54%). The differential transition probabilities of the categories of risk is evident in the second transition period as well, where about 50% of those exposed to adult use of none of the substances remained drug-free, as did about 47% of those exposed to any one substance, and only about 40% of those exposed to adult use of any two substances.

Of those adolescents who had experimented with alcohol only by 8th grade, about 71% of those exposed to none of the substances, 63% of those exposed to any one of the substances, and 60% of those exposed to any two of the substances remained in this status in 9th grade. Of the adolescents who had tried alcohol and tobacco, about 52% of those exposed to none of the substances, 49% of those exposed to any one substance, and 38% of those exposed to any two substances remained in this status in 9th grade. In addition, for those who had tried alcohol and tobacco by 8th grade, risk category of exposure to adult substance use seems to affect the probability of progressing to the most advanced latent status; about 21% of those exposed to none of the substances, 23% of those exposed to any one substance, and

32% of those exposed to any two substances progressed to the most advanced status by 9th grade. These patterns of findings suggest that exposure to adult use of any two of the substances assessed in this study places an adolescent at considerably more risk of accelerated onset than does exposure to any one or none of the substances.

Discussion

Many adolescents are exposed to some adult substance use; in our sample, 64 percent of adolescents experienced exposure to adult use of at least one substance. Our results indicate that this exposure is a risk factor in adolescent substance use onset. It appears that exposure to adult tobacco use presents the least risk, exposure to adult alcohol use is somewhat riskier, and exposure to adult marijuana use is the most potent risk. Exposure to adult use is associated with an increased probability of early initiation of the onset process and an increased likelihood of being in the higher use stages of this process. Similarly, exposure to adult use of multiple substances is associated with an increased risk of earlier initiation, an increased risk of membership in the higher use stages, and an increased rate of movement through some increasingly more advanced stages of substance use. Early initiation of substance use has been shown to be associated with more pervasive and more serious drug use behaviors later in life (Anthony & Petronis, 1995; Hawkins, Graham, Maguin, Abbott, & Catalano, in press; Robins & Przybeck, 1985).

Unfortunately, the present study cannot test competing hypotheses about the mechanisms by which adult use and child use are associated. However, it is interesting to speculate about what these mechanisms might be. One likely mechanism is modeling (Beman, 1995; Hansen et al., 1987; Peterson et al., 1994). When a child

grows up around important adults who are regular substance users, the child sees substance use as a normal part of adult life. This can even extend into child involvement in adult substance use, particularly in alcohol use (e.g., children may be allowed to pour or serve drinks) (Peterson et al., 1994). When the child reaches adolescence and wishes to appear more adult, substance use is perceived as a natural part of the adult role. Adults may also affect adolescents' substance use by influencing their perceptions of norms and attitudes toward drug use (Beman, 1995; Biddle et al., 1980; Chassin, 1984). Furthermore, children may observe that the adults in their lives use alcohol, tobacco, and other drugs as a way of coping with stress, and experiment with these substances looking for a way of coping with their own stress.

Another possible explanation for the observed relationship beween adult use and child experimentation is that adult caretakers who are regular substance users may not be as effective parents as their more abstemious counterparts. For example, Hansen et al. (1987) suggest that one important role of adult caretakers is "friendship screener," that is, approving and disapproving friend choices in order to reduce or eliminate undesirable peer influences. Adults who are substance users themselves may not be effective friendship screeners. Furthermore, in a household where substances are used, it is often easy for children and their friends to obtain substances to experiment with.

An alternative explanation for the relationship between adult use and child use is heredity. Numerous studies have demonstrated that a predisposition toward substance use can be genetically transmitted (Lawson, 1992). Thus children of substance users will tend to be substance users themselves, with the risk due not to exposure to adult

use, but to sharing of the adults' genes. In this study, we do not know which parents are biologically related to the children, so we cannot test this hypothesis.

Measurement of Adult Use

One important limitation of the present study is that adult use is measured only by child report, not by report of the adults themselves or by observation of the adults' behavior. Although it is possible that children may overestimate adult substance use behavior, it seems more likely that they may fail to observe some of it and therefore underestimate it. Some adults may deliberately hide their substance use behavior from the children in their household, so that the children are either unaware of it entirely or unaware of its extent. This raises an interesting question: Which is a more important influence, the adults' actual use, or the use that is perceived by the child? If the mechanism is modeling, then adult substance use would have an effect on child substance use only if the child observes the use taking place. Thus, to test a modeling hypothesis, it is best to have child reports of adult behavior, as we have in this study. However, to test hypotheses involving genetic transmission or ineffective parenting due to substance use, where adult use would have an effect even if it is entirely undetected by the child, it is best to have self-reports from the adults describing their own behavior, or direct behavioral observation. In reality, probably all of these mechanisms operate to some extent, so the ideal study would collect adult use data both by child report and by self-report or direct observation.

Implications for Interventions

This study suggests that adult substance use can be a powerful risk factor for adolescent experimentation with substances. Exactly what the implications of this finding are for the design of interventions depends upon the primary mechanism for the effect. Modeling and social influence can be combated in school-based prevention programs by presenting examples of attractive adult lifestyles that do not include substance use, and by incorporating program components designed to establish school social norms against substance use. Probably the best way to help adult caretakers to become effective at preventing the adoption of substance use by their children is family-based prevention. For example, parents can be taught how to model healthful lifestyles, and how to be responsible about screening their children's friends. Genetic predispositions toward drug use are more difficult to combat. Children with a family history of substance use should be watched carefully and perhaps given some additional intervention, if this can be done without stigmatizing the child.

Conclusions

The present study suggests that substance use by important adults is a potent risk factor for adolescent substance use experimentation. The risk appears to hold least for tobacco, an intermediate amount for alcohol, and most for marijuana. There is a risk associated with exposure to any one, any two, or all three substances. The present study cannot determine whether the risk is due to modeling of substance use behavior, ineffective parenting perhaps as a result of substance use, availability of substances in the home, or a genetic predisposition toward substance use shared by parent and child. This result should be investigated further in order to illuminate the

nature of the relationship between adult substance use and child substance use. Once this relationship is understood, prevention programs can be designed to mitigate the effects of adult substance use on adolescent experimentation.

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APPENDIX A:

Indicator Variables

Latent Status Indicators

Dichotomization
Responses in **bold** were recoded as "1".
Responses in *italics* were recoded as "2".

Experimentation with Tobacco

How many cigarettes have you smoked in your whole life?

1	**none**	*5*	*5 to 20 cigarettes*
2	*only one puff*	*6*	*1 to 5 packs*
3	*part or all of one cigarette*	*7*	*more than 5 packs*
4	*2 to 4 cigarettes*		

Experimentation with Alcohol

How many drinks of alcohol have you had in your whole life?

1	**none. I have never had even one sip of alcohol.**	*5*	*2 to 4*
2	**only sips FOR RELIGIOUS SERVICE**	*6*	*5 to 10*
3	*only sips (NOT for religious service)*	*7*	*11 to 20*
4	*part or all of one drink*	*8*	*21 to 100*
		9	*more than 100*

Experience of Drunkenness

How many times have you ever been drunk?

1	**never**	*4*	*5 to 10 times*
2	*only once*	*5*	*11 to 20 times*
3	*2 to 4 times*	*6*	*more than 20 times*

Advanced Use: Coded "2" if the dichotomized response:"2" for any of the following three items. Otherwise, coded "1".

How many cigarettes have you smoked in the past month (30 days)?

1	**none**	*4*	*2 to 4 cigarettes*
2	*only one puff*	*5*	*5 to 20 cigarettes*
3	*part or all of one cigarette*	*6*	*more than 1 pack*

How many drinks of alcohol have you had in the past month (30 days)?

1	**none.**	*5*	*2 to 4*
2	**only sips FOR RELIGIOUS SERVICE**	*6*	*5 to 10*
3	*only sips (NOT for religious service)*	*7*	*11 to 20*
4	*part or all of one drink*	*8*	*more than 20*

Have you ever used marijuana in your whole life?

1	*yes*
2	**no**

Latent Class Indicators

Dichotomization
Responses in **bold** were recoded as "1"..
Responses in *italics* were recoded as "2".

Adult Tobacco Use

Of the two most important adults in your life, how many smoke cigarettes?

1	**none**
2	*1*
3	*2*

Adult Alcohol Use

Of the two most important adults in your life, how many ever get drunk?

1	**none**
2	*1*
3	*2*

Alternate Adult Alcohol Use

Of the two most important adults in your life, how many drink alcohol about every day (Do NOT count religious service.)?

1	**none**
2	*1*
3	*2*

Adult Marijuana Use

Of the two most important adults in your life, how many ever smoke marijuana?

1	**none**
2	*1*
3	*2*

APPENDIX B:

Example SAS file

SAS FILE

```
LIBNAME SSD 'A:\AAPT';

*************************************************************************************************;
*  THIS SAS FILE CREATES LTA READ-ABLE DATA SETS FROM THE IMPUTED AAPT                           ;
*  DATA SET.  THIS INCLUDES A LC VARIABLE RE PARENTAL MARIJUANA USE                              ;
*  IT WAS CREATED BY ALLISON TRACY ON MARCH 28, 1996.                                            ;
*************************************************************************************************;
**************  CREATE SUBSAMPLE 1  DATA, BOTH TRANSITIONS  ***********;
DATA one;
INFILE 'A:\AAPT\ACD240XA.MLT';
INPUT
   WA14 WA15 WA16 XA19 XA20 XA23 WA24 WA35 RA39 RA41 RA82
   WA83 WA93 WA102 WA106 WA108
   WC14 WC15 WC16 XC19 XC20 XC23 WC24 WC35 RC39 RC41 RC82
   WD14 WD15 WD16 XD19 XD20 XD23 WD24 WD35 RD39 RD41 RD82 ;
RUN;

DATA TWO; SET ONE;
*** DICHOTOMIZATION FOR GRADE 7 ***;

 IF WA14 LE 1 THEN SMKLIFE7=1;IF WA14>1 THEN SMKLIFE7=2;
 IF XA19 LE 1 THEN ALCLIFE7=1;IF XA19>1 THEN ALCLIFE7=2;
 IF WA35 LE 1 THEN DRUNK7=1;IF WA35>1 THEN DRUNK7=2;
 IF WA15 LE 1 AND XA20 LE 1 AND RA39 LE 1 THEN ADVANCE7=1;
 IF WA15>1 OR XA20>1 OR RA39>1 THEN ADVANCE7=2;

*** DICHOTOMIZATION FOR GRADE 8 ***;

 IF WC14 LE 1 THEN SMKLIFE8=1;IF WC14>1 THEN SMKLIFE8=2;
 IF XC19 LE 1 THEN ALCLIFE8=1;IF XC19>1 THEN ALCLIFE8=2;
 IF WC35 LE 1 THEN DRUNK8=1;IF WC35>1 THEN DRUNK8=2;
 IF WC15 LE 1 AND XC20 LE 1 AND RC39 LE 1 THEN ADVANCE8=1;
 IF WC15>1 OR XC20>1 OR RC39>1 THEN ADVANCE8=2;

*** DICHOTOMIZATION FOR GRADE 9 ***;

 IF WD14 LE 1 THEN SMKLIFE9=1;IF WD14>1 THEN SMKLIFE9=2;
 IF XD19 LE 1 THEN ALCLIFE9=1;IF XD19>1 THEN ALCLIFE9=2;
 IF WD35 LE 1 THEN DRUNK9=1;IF WD35>1 THEN DRUNK9=2;
 IF WD15 LE 1 AND XD20 LE 1 AND RD39 LE 1 THEN ADVANCE9=1;
 IF WD15>1 OR XD20>1 OR RD39>1 THEN ADVANCE9=2;


*** DICHOTOMIZATION FOR LATENT CLASS PARENTS EVER SMOKE POT ***;
IF WA108 LE 1 THEN PPOT = 1; IF WA108 > 1 THEN PPOT = 2;
RUN;

DATA THREE;
SET TWO;
FILE 'TEMP1ALL.DAT';
PUT (PPOT SMKLIFE7 ALCLIFE7 DRUNK7 ADVANCE7
          SMKLIFE8 ALCLIFE8 DRUNK8 ADVANCE8
          SMKLIFE9 ALCLIFE9 DRUNK9 ADVANCE9)(1.);
RUN;

DATA SIX; INFILE 'TEMP1ALL.DAT'; INPUT PATTERN $ 1-13;
RUN;
PROC FREQ;
   TABLES PATTERN/OUT=FF LIST;
RUN;

DATA F; SET FF;
   N=2622;
   PERCENT=COUNT/N;
   FILE 'LCPOT1.LTA';
   PUT PATTERN  $ PERCENT 20.15;
RUN;
```

APPENDIX C:

Goodness of Fit Results

for Alternative Onset Models

AAPT/LTA Crossvalidation Results

7-8 grade (df)	Generated by 1st subsample	Crossvalidated on 2nd subsample	Generated by 2nd subsample	Crossvalidated on 1st subsample
Model 1 (199)	696.907	748.682	621.205	807.813
Model 2 (184)	538.058	601.357	474.702	649.384
Model 3 (184)	519.547	654.451	484.291	676.501
Model 4 (184)	546.117	635.658	484.920	676.574
Model 5 (167)	484.995	592.769	439.920	633.071

8-9 grade (df)				
Model 1 (199)	651.475	748.885	647.669	756.985
Model 2 (184)	465.332	654.112	499.523	598.234
Model 3 (184)	443.453	679.193	534.113	603.392
Model 4 (184)	532.908	632.720	512.191	656.592
Model 5 (167)	411.113	617.748	439.076	573.543
7-8-9 grade				
Model 1 (3997)	2106.795	2273.734	2076.994	2284.682
Model 2 (3968)	1778.662	2037.787	1806.606	2037.314
Model 3 (3968)	1835.428	2135.951	1885.508	2074.965
Model 4 (3968)	1876.917	2061.034	1820.141	2103.675
Model 5 (3935)	1691.197	1995.999	1706.132	1987.169

APPENDIX D:

Goodness of Fit Results for

First and Second Order Models

(Complete and Imputed Data)

Model 5 AAPT/LTA Results

First Order	Estimated on 1st subsample	Crossvalidated on 2nd subsample	Estimated on 2nd subsample	Crossvalidated on 1st subsample
Complete Only (3935 df)	1691.197	1995.999	1706.132	1987.169
Imputed (3935 df)	1900.142	1999.819	1774.102	2124.849

Second Order	Estimated on 1st subsample	Crossvalidated on 2nd subsample	Estimated on 2nd subsample	Crossvalidated on 1st subsample
Complete Only (3789 df)	1771.441	2148.127	1800.700	2150.755
Imputed (3789 df)	2113.583	2292.942	2045.298	2353.928

Complete Only: n = 2195

Imputed: n = 2620

APPENDIX E:

Goodness of Fit Results for

Alternative Latent Class Model Constraints

AAPT/LTA MODEL 5

with Exposure to Adult Use of Alcohol Latent Class:

Imputed Data[1]

	Generated by 1st subsample	Crossvalidated on 2nd subsample	Generated by 2nd subsample	Crossvalidated on 1st subsample
2 latent class rhos estimated (8046 df)	2876.686	2952.033	2731.034	3103.122
1 latent class rho estimated (8047 df)	2877.693	2946.744	2731.055	3103.090
1 lc rho and illegal taus=0 (8037 df)	2777.319	2855.558	2574.981	3060.259
1 lc rho, illegal taus=0, second order (7901 df)	2668.050	2950.359	2460.981	3163.670

[1]For these analyses only, the latent classes were defined by reported exposure to adult drunkenness.

APPENDIX F:

Example LTA Command File

LTA Command File

```
* L3S1V1O1.LTA
* This is the LTA program testing model 5 of the
* substance use onset models (AAPT).  This model
* also incorporates as a latent class
* adult use as measured by adolescents' reports of
* exposure to adults' who have smoked marijuana.

2 9 1 4 2620 3 1 1 1
1 5000 .0000001 651

2

2 2 2 2

1 1

1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1

1 1 1 1 1 1 1 1 1
0 1 0 1 1 1 1 1 1
0 0 1 1 0 0 1 1 1
0 0 0 1 0 0 1 1 1
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0 0 0 0 1 1 1 0 1
0 0 0 0 0 0 1 0 1
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0 0 0 0 1 1 1 0 1
0 0 0 0 1 1 1 0 1
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0 0 0 1 0 0 1 1 1
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0 0 0 0 0 0 1 0 1

2
3

3
2
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3 4 6 8
3 5 6 8
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2 5 7 9
3 5 7 8
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3 5 7 9

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3 4 6 8
2 4 6 9
2 4 7 8
2 4 6 8

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3 5 6 9
3 5 7 9

3 5 7 9
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2 4 6 8

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2 5 7 9
3 5 7 8
3 5 6 9
3 5 7 9

3 5 7 9
3 4 7 9
2 5 7 9
2 4 7 9
3 4 6 9
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3 4 6 8
2 4 6 9
2 4 7 8
2 4 6 8

.2 .8

.2 .1 .1 .1 .1 .1 .1 .1 .1
.1 .2 .1 .1 .1 .1 .1 .1 .1

.20 .10 .10 .10 .10 .10 .10 .10 .10
.00 .20 .00 .13 .13 .13 .13 .13 .15
.00 .00 .20 .20 .00 .00 .20 .20 .20
.00 .00 .00 .20 .00 .00 .26 .26 .28
.00 .00 .00 .00 .20 .26 .26 .00 .28
.00 .00 .00 .00 .26 .20 .26 .00 .28
.00 .00 .00 .00 .00 .00 .20 .00 .80
.00 .00 .00 .28 .00 .00 .20 .26 .26
.00 .00 .00 .00 .00 .00 .80 .00 .20

.20 .10 .10 .10 .10 .10 .10 .10 .10
.00 .20 .00 .13 .13 .13 .13 .13 .15
.00 .00 .20 .20 .00 .00 .20 .20 .20
.00 .00 .00 .20 .00 .00 .26 .26 .28
.00 .00 .00 .00 .20 .26 .26 .00 .28
.00 .00 .00 .00 .26 .20 .26 .00 .28
.00 .00 .00 .00 .00 .00 .20 .00 .80
.00 .00 .00 .28 .00 .00 .20 .26 .26
.00 .00 .00 .00 .00 .00 .80 .00 .20

.20 .10 .10 .10 .10 .10 .10 .10 .10
.00 .20 .00 .13 .13 .13 .13 .13 .15
.00 .00 .20 .20 .00 .00 .20 .20 .20
.00 .00 .00 .20 .00 .00 .26 .26 .28
.00 .00 .00 .00 .20 .26 .26 .00 .28
.00 .00 .00 .00 .26 .20 .26 .00 .28
.00 .00 .00 .00 .00 .00 .20 .00 .80
.00 .00 .00 .28 .00 .00 .20 .26 .26
.00 .00 .00 .00 .00 .00 .80 .00 .20

.20 .10 .10 .10 .10 .10 .10 .10 .10
.00 .20 .00 .13 .13 .13 .13 .13 .15
.00 .00 .20 .20 .00 .00 .20 .20 .20
.00 .00 .00 .20 .00 .00 .26 .26 .28
.00 .00 .00 .00 .20 .26 .26 .00 .28
.00 .00 .00 .00 .26 .20 .26 .00 .28
.00 .00 .00 .00 .00 .00 .20 .00 .80
.00 .00 .00 .28 .00 .00 .20 .26 .26
.00 .00 .00 .00 .00 .00 .80 .00 .20

.3
.7

.7
.3

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.10 .90 .90 .90
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.90 .90 .90 .90

APPENDIX G:

Goodness of Fit Results

for Separate Latent Class Models

Latent Class/Latent Status Models

	Sample 1		Sample 2	
	"a" starting values	"b" starting values	"a" starting values	"b" starting values
Adult Alcohol Use (8041 df)	2893.261	2893.261	2712.693	2712.693
Adult Tobacco Use (8041 df)	2969.409	2969.409	2820.448	2815.788
Adult Marijuana Use (8041 df)	2679.733	2679.733	2565.527	2565.766
Risk Categories of Adult Exposure (16,087 df)	3610.431	3610.432	3354.575	3354.575

Crossvalidation Results

	Sample 1	Sample 2
Adult Alcohol Use (8041 df)	2969.226	3152.184
Adult Tobacco Use (8041 df)	3059.744	3206.872
Adult Marijuana Use (8041 df)	2903.143	3011.668
Risk Categories of Adult Exposure (16,087 df)	3811.140	4124.262

APPENDIX H:

Delta Parameter Estimates for Model of Exposure to Adult Alcohol Use

Delta Parameter Estimates

Adult Alcohol Use Model*

Exposed Adolescents	Latent Status	Grade 7	Grade 8	Grade 9
LC 1	LS 1	.209(.219)	.124(.116)	.051(.057)
LC 1	LS 2	.259(.238)	.234(.225)	.169(.195)
LC 1	LS 3	.033(.036)	.007(.017)	.005(.008)
LC 1	LS 4	.146(.133)	.165(.127)	.108(.106)
LC 1	LS 5	.008(.012)	.009(.003)	.014(.003)
LC 1	LS 6	.021(.010)	.019(.018)	.037(.025)
LC 1	LS 7	.031(.027)	.017(.014)	.018(.002)
LC 1	LS 8	.118(.148)	.136(.164)	.143(.133)
LC 1	LS 9	.177(.178)	.289(.317)	.454(.472)

Unexposed Adolescents	Latent Status	Time 1	Grade 8	Grade 9
LC 2	LS 1	.401(.421)	.255(.261)	.126(.124)
LC 2	LS 2	.240(.248)	.274(.268)	.241(.239)
LC 2	LS 3	.036(.033)	.029(.029)	.024(.029)
LC 2	LS 4	.147(.122)	.152(.153)	.127(.125)
LC 2	LS 5	.014(.016)	.009(.020)	.014(.017)
LC 2	LS 6	.009(.006)	.017(.007)	.034(.029)
LC 2	LS 7	.019(.023)	.026(.016)	.032(.034)
LC 2	LS 8	.084(.067)	.108(.102)	.143(.125)
LC 2	LS 9	.050(.065)	.129(.145)	.259(.279)

*Sample 1 (Sample 2)

APPENDIX I:

Tau Parameter Estimates for Model of Exposure to Adult Alcohol Use

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Alcohol Use

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.594 *.529*	.212 *.236*	.000 *.004*	.079 *.133*	.004 *.000*	.001 *.003*	.000 *.011*	.052 *.075*	.057 *.009*
LS 2	X	.734 *.728*	X	.101 *.045*	.017 .004	.004 *.024*	.005 *.011*	.092 *.093*	.047 *.095*
LS 3	X	X	.203 *.445*	.561 *.091*	X	X	.000 *.081*	.236 *.285*	.000 *.098*
LS 4	X	X	X	.609 *.462*	X	X	.000 *.003*	.240 *.325*	.151 *.210*
LS 5	X	X	X	X	.000 *.144*	.049 *.392*	.199 *.006*	X	.752 *.459*
LS 6	X	X	X	X	.163 *.000*	.809 *.647*	.027 *.000*	X	.000 *.353*
LS 7	X	X	X	X	X	X	.000 *.198*	X	1.00 *.802*
LS 8	X	X	X	.127 *.156*	X	X	.007 *.000*	.500 *.492*	.366 *.352*
LS 9	X	X	X	X	X	X	.073 *.000*	X	.927 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Alcohol Use

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.407 *.493*	.221 *.284*	.042 *.024*	.118 *.111*	.009 *.000*	.066 *.031*	.000 *.011*	.066 *.040*	.070 *.005*
LS 2	X	.603 *.723*	X	.049 *.029*	.006 .000	.104 *.053*	.000 *.001*	.178 *.091*	.062 *.102*
LS 3	X	X	.000 *.296*	.579 *.284*	X	X	.196 *.000*	.068 *.331*	.158 *.089*
LS 4	X	X	X	.373 *.495*	X	X	.000 *.000*	.256 *.278*	.371 *.227*
LS 5	X	X	X	X	.441 *1.00*	.559 *.000*	.000 *.000*	X	.000 *.000*
LS 6	X	X	X	X	.421 *.000*	.000 *.549*	.000 *.000*	X	.579 *.451*
LS 7	X	X	X	X	X	X	1.00 *.000*	X	.000 *1.00*
LS 8	X	X	X	.124 *.113*	X	X	.000 *.000*	.373 *.405*	.503 *.483*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2-- Adolescents NOT Exposed to Adult Alcohol Use

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.635 *.620*	.203 *.204*	.027 *.037*	.064 *.085*	.005 *.011*	.002 *.000*	.013 *.000*	.041 *.017*	.009 *.025*
LS 2	X	.802 *.735*	X	.067 *.093*	.019 .010	.029 *.017*	.008 *.000*	.035 *.104*	.040 *.042*
LS 3	X	X	.494 *417*	.116 *.300*	X	X	.096 *.000*	.204 *.111*	.089 *.173*
LS 4	X	X	X	.612 *.556*	X	X	.019 *.026*	.253 *.276*	.117 *.142*
LS 5	X	X	X	X	.211 *645*	.188 *.000*	.145 *.000*	X	.456 *.354*
LS 6	X	X	X	X	.000 *.422*	.780 *.531*	.000 *.000*	X	.220 *.047*
LS 7	X	X	X	X	X	X	.394 *.468*	X	.606 *.532*
LS 8	X	X	X	.191 *.239*	X	X	.000 *.014*	.465 *.476*	.344 *.271*
LS 9	X	X	X	X	X	X	.069 *.010*	X	.931 *.990*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2 -- Adolescents NOT Exposed to Adult Alcohol Use

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.495 *.476*	.233 *.251*	.033 *.063*	.093 *.074*	.000 *.012*	.034 *.016*	.006 *.014*	.056 *.049*	.049 *.044*
LS 2	X	.663 *.648*	X	.027 *.068*	.005 022	.069 *.057*	.047 *.013*	.122 *.118*	.067 *.074*
LS 3	X	X	.536 *.424*	.044 *.203*	X	X	.000 *.110*	.383 *.181*	.038 *.082*
LS 4	X	X	X	.510 *.453*	X	X	.038 *.075*	.284 *.184*	.168 *.288*
LS 5	X	X	X	X	.909 *.376*	.091 *.281*	.000 *.072*	X	.000 *.271*
LS 6	X	X	X	X	.246 *.036*	.333 *.571*	.013 *.000*	X	.408 *.394*
LS 7	X	X	X	X	X	X	.430 *.663*	X	.570 *.337*
LS 8	X	X	X	.154 *.118*	X	X	.000 *.000*	.382 *.457*	.464 *.425*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

APPENDIX J:

Delta Parameter Estimates for Model of Exposure to Adult Tobacco Use

Delta Parameter Estimates
Adult Tobacco Use Model*

Exposed Adolescents	Latent Status	Grade 7	Grade 8	Grade 9
LC 1	LS 1	.306(.321)	.185(.200)	.076(.101)
LC 1	LS 2	.208(.221)	.222(.212)	.163(.165)
LC 1	LS 3	.038(.038)	.026(.024)	.017(.019)
LC 1	LS 4	.157(.136)	.161(.146)	.123(.126)
LC 1	LS 5	.018(.018)	.012(.011)	.018(.016)
LC 1	LS 6	.010(.002)	.016(.009)	.032(.021)
LC 1	LS 7	.027(.035)	.025(.022)	.025(.024)
LC 1	LS 8	.118(.086)	.126(.123)	.157(.118)
LC 1	LS 9	.118(.142)	.228(.253)	.389(.410)

Unexposed Adolescents	Latent Status	Grade 7	Grade 8	Grade 9
LC 2	LS 1	.394(.414)	.254(.243)	.136(.110)
LC 2	LS 2	.285(.271)	.307(.304)	.281(.295)
LC 2	LS 3	.031(.030)	.020(.028)	.021(.028)
LC 2	LS 4	.136(.112)	.150(.147)	.121(.115)
LC 2	LS 5	.009(.010)	.006(.014)	.014(.010)
LC 2	LS 6	.012(.015)	.022(.014)	.037(.035)
LC 2	LS 7	.016(.014)	.022(.011)	.031(.024)
LC 2	LS 8	.066(.091)	.102(.115)	.129(.137)
LC 2	LS 9	.051(.043)	.116(.125)	.231(.247)

*Sample 1 (Sample 2)

APPENDIX K:

Tau Parameter Estimates for Model of Exposure to Adult Tobacco Use

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Tobacco Use

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.605.*6* *24*	.200 *.172*	.033 *.038*	.064 *.089*	.006 *.007*	.000 *.001*	.006 *.001*	.061 *.041*	.025 *.026*
LS 2	X	.770 *.711*	X	.091 *.073*	.032 .007	.017 *.018*	.012 *.002*	.039 *.128*	.040 *.060*
LS 3	X	X	.423 *.300*	.169 *.286*	X	X	.148 *.000*	.184 *.208*	.076 *.206*
LS 4	X	X	X	.614 *.536*	X	X	.032 *.054*	.216 *.240*	.138 *.169*
LS 5	X	X	X	X	.107 *.369*	.159 *.179*	.000 *.067*	X	.734 *.384*
LS 6	X	X	X	X	.114 *.321*	.886 *.679*	.000 *.000*	X	.000 *.000*
LS 7	X	X	X	X	X	X	.018 *.358*	X	.982 *.642*
LS 8	X	X	X	.173 *.197*	X	X	.002 *.001*	.494 *.473*	.331 *.329*
LS 9	X	X	X	X	X	X	.075 *.000*	X	.925 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Tobacco Use

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.410 *.507*	.204 *.191*	.023 *.054*	.162 *.107*	.000 *.000*	.048 *.024*	.000 *.030*	.093 *.043*	.060 *.045*
LS 2	X	.563 *.595*	X	.053 *.072*	.020 .040	.075 *.037*	.044 *.022*	.145 *.128*	.100 *.105*
LS 3	X	X	.500 *.331*	.120 *.240*	X	X	.000 *.035*	.380 *.172*	.000 *.221*
LS 4	X	X	X	.364 *.477*	X	X	.013 *.027*	.323 *.195*	.299 *.301*
LS 5	X	X	X	X	.829 *.354*	.171 *.464*	.000 *.000*	X	.000 *.182*
LS 6	X	X	X	X	.290 *.327*	.287 *.369*	.000 *.000*	X	.423 *.305*
LS 7	X	X	X	X	X	X	.535 *.399*	X	.465 *.601*
LS 8	X	X	X	.153 *.113*	X	X	.000 *.000*	.358 *.405*	.489 *.482*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2-- Adolescents NOT Exposed to Adult Tobacco Use

	Grade 8								
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.645 *.588*	.208 *.237*	.020 *.026*	.068 *.100*	.002 *.014*	.008 *.000*	.012 *.000*	.027 *.014*	.010 *.021*
LS 2	X	.791 *.760*	X	.069 *.085*	.012 .006	.024 *.016*	.000 *.000*	.057 *.078*	.047 *.056*
LS 3	X	X	.402 *.571*	.321 *.202*	X	X	.000 *.058*	.245 *.093*	.032 *.075*
LS 4	X	X	X	.616 *.502*	X	X	.006 *.000*	.272 *.364*	.106 *.133*
LS 5	X	X	X	X	.246 *.592*	.185 *.114*	.569 *.118*	X	.000 *.177*
LS 6	X	X	X	X	.000 *.034*	.861 *.547*	.000 *.000*	X	.139 *.419*
LS 7	X	X	X	X	X	X	.562 *.516*	X	.438 *.484*
LS 8	X	X	X	.147 *.216*	X	X	.000 *.004*	.460 *.484*	.394 *.296*
LS 9	X	X	X	X	X	X	.053 *.022*	X	.947 *.978*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2 -- Adolescents NOT Exposed to Adult Tobacco Use

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.537 *.451*	.245 *.316*	.039 *.062*	.047 *.055*	.014 *.016*	.027 *.015*	.009 *.000*	.034 *.055*	.047 *.028*
LS 2	X	.713 *.717*	X	.019 *.048*	.000 .000	.079 *.073*	.018 *.000*	.124 *.096*	.047 *.066*
LS 3	X	X	.524 *.471*	.000 *.207*	X	X	.102 *.108*	.284 *.215*	.090 *.000*
LS 4	X	X	X	.617 *.457*	X	X	.027 *.073*	.214 *.218*	.142 *.252*
LS 5	X	X	X	X	.783 *.436*	.169 *.068*	.000 *.337*	X	.048 *.158*
LS 6	X	X	X	X	.255 *.000*	.202 *.565*	.056 *.000*	X	.487 *.435*
LS 7	X	X	X	X	X	X	.506 *.506*	X	.494 *.494*
LS 8	X	X	X	.103 *.119*	X	X	.000 *.000*	.436 *.488*	.461 *.392*
LS 9	X	X	X	X	X	X	.033 *.000*	X	.967 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

APPENDIX L:

Delta Parameter Estimates for Model of Exposure to Adult Marijuana Use

Delta Parameter Estimates

Adult Marijuana Use Model*

Exposed Adolescents	Latent Status	Grade 7	Grade 8	Grade 9
LC 1	LS 1	.170(.126)	.075(.063)	.032(.032)
LC 1	LS 2	.159(.094)	.201(.073)	.118(.058)
LC 1	LS 3	.011(.025)	.000(.020)	.000(.006)
LC 1	LS 4	.058(.132)	.107(.058)	.059(.062)
LC 1	LS 5	.019(.027)	.022(.014)	.021(.020)
LC 1	LS 6	.017(.012)	.018(.025)	.022(.024)
LC 1	LS 7	.008(.038)	.018(.024)	.022(.024)
LC 1	LS 8	.202(.152)	.134(.152)	.123(.087)
LC 1	LS 9	.357(.395)	.425(.571)	.612(.679)

Unexposed Adolescents	Latent Status	Grade 7	Grade 8	Grade 9
LC 2	LS 1	.369(.396)	.234(.242)	.113(.115)
LC 2	LS 2	.256(.264)	.271(.279)	.233(.250)
LC 2	LS 3	.038(.036)	.027(.025)	.022(.026)
LC 2	LS 4	.157(.123)	.161(.157)	.130(.128)
LC 2	LS 5	.013(.013)	.008(.014)	.014(.011)
LC 2	LS 6	.012(.007)	.018(.009)	.038(.027)
LC 2	LS 7	.024(.023)	.023(.016)	.026(.023)
LC 2	LS 8	.079(.081)	.112(.116)	.145(.131)
LC 2	LS 9	.052(.058)	.146(.142)	.280(.290)

*Sample 1 (Sample 2)

APPENDIX M:

Tau Parameter Estimates for Model of Exposure to Adult Marijuana Use

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Marijuana Use

			Grade 8						
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.444 *.499*	.475 *.104*	.000 *.057*	.036 *.118*	.027 *.028*	.000 *.000*	.000 *.000*	.019 *.179*	.000 *.015*
LS 2	X	.754 *.635*	X	.047 *.003*	.002 .000	.052 *.000*	.000 *.000*	.136 *.206*	.009 *.157*
LS 3	X	X	.000 *.524*	.476 *.000*	X	X	.300 *.000*	.225 *.000*	.000 *.476*
LS 4	X	X	X	.619 *.236*	X	X	.123 *.000*	.055 *.362*	.204 *.402*
LS 5	X	X	X	X	.536 *.054*	.000 *.849*	.000 *.097*	X	.464 *.000*
LS 6	X	X	X	X	.416 *.808*	.584 *.192*	.000 *.000*	X	.000 *.000*
LS 7	X	X	X	X	X	X	.000 *.266*	X	1.00 *.734*
LS 8	X	X	X	.259 *.076*	X	X	.000 *.063*	.513 *.409*	.228 *.451*
LS 9	X	X	X	X	X	X	.021 *.004*	X	.979 *.996*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Marijuana Use

	Grade 9								
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.425 *.508*	.347 *.303*	.000 *.092*	.021 *.034*	.000 *.000*	.041 *.000*	.046 *.000*	.000 *.063*	.121 *.000*
LS 2	X	.456 *.541*	X	.045 *.032*	.000 .078	.055 *.243*	.000 *.047*	.325 *.059*	.119 *.000*
LS 3	X	X	.189 *.000*	.190 *.243*	X	X	.192 *.297*	.191 *.159*	.237 *.301*
LS 4	X	X	X	.426 *.207*	X	X	.170 *.128*	.098 *.412*	.306 *.252*
LS 5	X	X	X	X	.955 *.000*	.000 *1.00*	.000 *.000*	X	.045 *.000*
LS 6	X	X	X	X	.000 *.569*	.000 *.000*	.000 *.000*	X	1.00 *.431*
LS 7	X	X	X	X	X	X	.000 *.282*	X	1.00 *.718*
LS 8	X	X	X	.018 *.269*	X	X	.000 *.000*	.353 *.339*	.629 *.392*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2-- Adolescents NOT Exposed to Adult Marijuana Use

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.635 *.612*	.192 *.214*	.030 *.028*	.066 *.092*	.003 *.008*	.002 *.000*	.009 *.002*	.043 *.022*	.021 *.023*
LS 2	X	.781 *.738*	X	.083 *.082*	.020 .009	.019 *.019*	.007 *.005*	.044 *.100*	.045 *.047*
LS 3	X	X	.427 *.399*	.220 *.283*	X	X	.068 *.008*	.219 *.184*	.067 *.126*
LS 4	X	X	X	.608 *.568*	X	X	.020 *.031*	.256 *.278*	.116 *.122*
LS 5	X	X	X	X	.118 *.549*	.220 *.000*	.143 *.073*	X	.519 *.378*
LS 6	X	X	X	X	.000 *.157*	.764 *.493*	.000 *.000*	X	.236 *.350*
LS 7	X	X	X	X	X	X	.229 *.409*	X	.771 *.591*
LS 8	X	X	X	.152 *.236*	X	X	.000 *.000*	.461 *.489*	.387 *.275*
LS 9	X	X	X	X	X	X	.095 *.000*	X	.905 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2 -- Adolescents NOT Exposed to Adult Marijuana Use

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.483 *.474*	.227 *.257*	.036 *.057*	.101 *.081*	.002 *.007*	.040 *.021*	.002 *.015*	.059 *.048*	.050 *.039*
LS 2	X	.662 *.673*	X	.033 *.059*	.006 .009	.079 *.051*	.033 *.010*	.119 *.113*	.066 *.086*
LS 3	X	X	.480 *.464*	.099 *.206*	X	X	.031 *.070*	.340 *.215*	.050 *.045*
LS 4	X	X	X	.482 *.481*	X	X	.013 *.044*	.286 *.193*	.220 *.281*
LS 5	X	X	X	X	.779 *.455*	.221 *.224*	.000 *.089*	X	.000 *.232*
LS 6	X	X	X	X	.317 *.000*	.305 *.530*	.000 *.000*	X	.378 *.470*
LS 7	X	X	X	X	X	X	.588 *.374*	X	.412 *.626*
LS 8	X	X	X	.155 *.097*	X	X	.000 *.000*	.389 *.454*	.456 *.450*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

APPENDIX N:

Delta Parameter Estimates

for Risk Category Model

Delta Parameter Estimates

Risk Category Model*

Latent Class	Latent Status	Grade 7	Grade 8	Grade 9
LC 1	LS 1	.445(.469)	.294(.284)	.155(.132)
LC 1	LS 2	.279(.268)	.311(.302)	.307(.298)
LC 1	LS 3	.028(.030)	.024(.032)	.027(.031)
LC 1	LS 4	.134(.098)	.146(.159)	.120(.117)
LC 1	LS 5	.008(.011)	.010(.021)	.013(.015)
LC 1	LS 6	.013(.014)	.019(.007)	.035(.032)
LC 1	LS 7	.019(.018)	.023(.006)	.034(.031)
LC 1	LS 8	.048(.068)	.091(.093)	.125(.131)
LC 1	LS 9	.027(.025)	.082(.096)	.184(.212)

Latent Class	Latent Status	Grade 7	Grade 8	Grade 9
LC 2	LS 1	.339(.369)	.208(.228)	.101(.106)
LC 2	LS 2	.237(.262)	.249(.276)	.181(.228)
LC 2	LS 3	.048(.038)	.034(.025)	.018(.027)
LC 2	LS 4	.167(.145)	.163(.148)	.142(.135)
LC 2	LS 5	.017(.015)	.007(.010)	.013(.006)
LC 2	LS 6	.007(.003)	.016(.010)	.039(.027)
LC 2	LS 7	.016(.020)	.027(.026)	.040(.031)
LC 2	LS 8	.102(.074)	.126(.122)	.157(.128)
LC 2	LS 9	.066(.075)	.170(.155)	.310(.312)

*Sample 1 (Sample 2)

Risk Category Model (cont.)*

Latent Class	Latent Status	Grade 7	Grade 8	Grade 9
LC 3	LS 1	.232(.215)	.120(.120)	.030(.073)
LC 3	LS 2	.217(.212)	.223(.180)	.165(.136)
LC 3	LS 3	.026(.034)	.010(.016)	.009(.003)
LC 3	LS 4	.151(.140)	.178(.131)	.092(.121)
LC 3	LS 5	.010(.024)	.017 .008)	.025(.016)
LC 3	LS 6	.023(.009)	.016(.026)	.031(.024)
LC 3	LS 7	.045(.047)	.025(.023)	.014(.010)
LC 3	LS 8	.157(.160)	.140(.177)	.174(.133)
LC 3	LS 9	.139(.160)	.271(.319)	.459(.484)

Latent Class	Latent Status	Grade 7	Grade 8	Grade 9
LC 4	LS 1	.114(.099)	.075(.049)	.043(.015)
LC 4	LS 2	.164(.059)	.149(.017)	.081(.034)
LC 4	LS 3	.016(.027)	.000(.017)	.000(.000)
LC 4	LS 4	.032(.084)	.077(.044)	.064(.023)
LC 4	LS 5	.016(.010)	.009(.000)	.009(.007)
LC 4	LS 6	.010(.000)	.016(.007)	.010(.017)
LC 4	LS 7	.002(.040)	.018(.017)	.014(.028)
LC 4	LS 8	.124(.110)	.100(.125)	.053(.054)
LC 4	LS 9	.522(.571)	.555(.723)	.727(.820)

*Sample 1 (Sample 2)

APPENDIX O:

Tau Parameter Estimates

for Risk Category Model

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Use of None of the Substances

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.659 *.605*	.200 *.225*	.021 *.032*	.058 *.088*	.002 *.016*	.007 *.000*	.015 *.000*	.035 *.008*	.003 *.027*
LS 2	X	.797 *.735*	X	.069 *.111*	.024 .009	.023 *.011*	.000 *.000*	.043 *.089*	.044 *.046*
LS 3	X	X	.511 *.563*	.289 *.333*	X	X	.026 *.000*	.160 *.032*	.013 *.072*
LS 4	X	X	X	.604 *.597*	X	X	.002 *.005*	.289 *.361*	.105 *.037*
LS 5	X	X	X	X	.114 *.785*	.317 *.000*	.543 *.000*	X	.026 *.215*
LS 6	X	X	X	X	.168 *.202*	.553 *.328*	.000 *.000*	X	.278 *.471*
LS 7	X	X	X	X	X	X	.569 *.301*	X	.431 *.699*
LS 8	X	X	X	.250 *.286*	X	X	.000 *.000*	.429 *.428*	.320 *.286*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 1 -- Adolescents Exposed to Adult Use of None of the Substances

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.526 *.466*	.277 *.306*	.046 *.056*	.036 *.052*	.009 *.021*	.025 *.019*	.003 *.001*	.037 *.045*	.041 *.033*
LS 2	X	.725 *.698*	X	.029 *.067*	.003 .003	.065 *.067*	.026 *.000*	.110 *.099*	.043 *.065*
LS 3	X	X	.562 *.478*	.000 *.114*	X	X	.070 *.143*	.330 *.265*	.038 *.000*
LS 4	X	X	X	.614 *.420*	X	X	.027 *.078*	.235 *.213*	.124 *.289*
LS 5	X	X	X	X	.531 *.394*	.020 *.136*	.000 *.268*	X	.450 *.202*
LS 6	X	X	X	X	.236 *.000*	.378 *.501*	.148 *.000*	X	.237 *.499*
LS 7	X	X	X	X	X	X	.395 *.996*	X	.605 *.004*
LS 8	X	X	X	.117 *.121*	X	X	.000 *.016*	.414 *.496*	.469 *.367*
LS 9	X	X	X	X	X	X	.089 *.008*	X	.911 *.992*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2-- Adolescents Exposed to Adult Use of Any One of the Substances

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.614 *.619*	.189 *.204*	.040 *.033*	.079 *.092*	.002 *.003*	.000 *.003*	.007 *.000*	.042 *.033*	.027 *.013*
LS 2	X	.782 *.767*	X	.064 *.057*	.016 .008	.027 *.024*	.011 *.000*	.047 *.101*	.053 *.042*
LS 3	X	X	.423 *.344*	.112 *.220*	X	X	.069 *.005*	.265 *.222*	.131 *.208*
LS 4	X	X	X	.610 *.520*	X	X	.032 *.040*	.240 *.244*	.117 *.196*
LS 5	X	X	X	X	.165 *.386*	.248 *.000*	.130 *.218*	X	.456 *.396*
LS 6	X	X	X	X	.000 *.225*	.707 *.775*	.132 *.000*	X	.161 *.000*
LS 7	X	X	X	X	X	X	.017 *.680*	X	.983 *.320*
LS 8	X	X	X	.133 *.206*	X	X	.000 *.012*	.468 *.538*	.399 *.245*
LS 9	X	X	X	X	X	X	.148 *.032*	X	.852 *.968*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 2 -- Adolescents Exposed to Adult Use of Any One of the Substances

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.486 *.463*	.133 *.214*	.018 *.073*	.164 *.101*	.002 *.000*	.045 *.012*	.012 *.025*	.079 *.064*	.060 *.049*
LS 2	X	.614 *.648*	X	.025 *.052*	.000 .010	.099 *.055*	.059 *.016*	.126 *.129*	.076 *.090*
LS 3	X	X	.417 *.418*	.160 *.359*	X	X	.013 *.005*	.318 *.044*	.092 *.173*
LS 4	X	X	X	.452 *.527*	X	X	.032 *.045*	.306 *.172*	.210 *.255*
LS 5	X	X	X	X	.999 *.390*	.001 *.272*	.000 *.000*	X	.000 *.338*
LS 6	X	X	X	X	.348 *.000*	.275 *.648*	.000 *.000*	X	.378 *.352*
LS 7	X	X	X	X	X	X	.630 *.529*	X	.370 *.471*
LS 8	X	X	X	.179 *.086*	X	X	.000 *.000*	.383 *.423*	.438 *.491*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 3 -- Adolescents Exposed to Adult Use Of Any Two of the Substances

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.515 *.557*	.269 *.171*	.028 *.039*	.060 *.117*	.023 *.010*	.000 *.003*	.000 *.015*	.065 *.052*	.040 *.035*
LS 2	X	.742 *.675*	X	.149 *.045*	.024 .000	.000 *.019*	.010 *.034*	.063 *.145*	.013 *.083*
LS 3	X	X	.148 *.210*	.631 *.243*	X	X	.221 *.000*	.000 *.377*	.000. *170*
LS 4	X	X	X	.631 *.480*	X	X	.000 *.000*	.216 *.275*	.153 *.245*
LS 5	X	X	X	X	.000 *.071*	.000 *.699*	.000 *.013*	X	1.00 *.217*
LS 6	X	X	X	X	.256 *.469*	.694 *.531*	.000 *.000*	X	.050 *.000*
LS 7	X	X	X	X	X	X	.014 *.242*	X	.986 *.758*
LS 8	X	X	X	.132 *.133*	X	X	.011 *.008*	.500 *.522*	.357 *.337*
LS 9	X	X	X	X	X	X	.103 *.000*	X	.897 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 3 -- Adolescents Exposed to Adult Use of Any Two of the Substances

		Grade 9							
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.254 *.611*	.359 *.152*	.034 *.009*	.130 *.128*	.000 *.000*	.079 *.053*	.000 *.023*	.095 *.011*	.049 *.012*
LS 2	X	.545 *.654*	X	.038 *.068*	.056 .046	.056 *.013*	.000 *.020*	.216 *.089*	.089 *.110*
LS 3	X	X	.501 *.149*	.192 *.369*	X	X	.000 *.243*	.307 *.239*	.000 *.000*
LS 4	X	X	X	.296 *.467*	X	X	.000 *.000*	.321 *.269*	.383 *.265*
LS 5	X	X	X	X	.532 *.000*	.441 *1.00*	.000 *.000*	X	.027 *.000*
LS 6	X	X	X	X	.263 *.309*	.099 *.278*	.000 *.000*	X	.638 *.413*
LS 7	X	X	X	X	X	X	.571 *.000*	X	.429 *1.00*
LS 8	X	X	X	.097 *.147*	X	X	.000 *.000*	.386 *.432*	.517 *.421*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 4-- Adolescents Exposed to Adult Use of All Three Substances

		Grade 8							
Grade 7	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.665 *.501*	.265 *.084*	.000 *.000*	.000 *.000*	.000 *.000*	.000 *.000*	.000 *.000*	.070 *.414*	.000 *.000*
LS 2	X	.728 *.150*	X	.000 *.000*	.052 .000	.052 *.000*	.000 *.000*	.119 *.660*	.048 *.190*
LS 3	X	X	.000 *.629*	.490 *.000*	X	X	.000 *.000*	.510 *.000*	.000 *.371*
LS 4	X	X	X	.322 *.092*	X	X	.313 *.194*	.138 *.539*	.227 *.175*
LS 5	X	X	X	X	.000 *.000*	.000 *.749*	.000 *.000*	X	1.00 *.251*
LS 6	X	X	X	X	.000 *.013*	.716 *.014*	.284 *.017*	X	.000 *.956*
LS 7	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*
LS 8	X	X	X	.475 *.332*	X	X	.043 *.000*	.482 *.000*	.000 *.668*
LS 9	X	X	X	X	X	X	.000 *.001*	X	1.00 *.999*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

Tau Parameter Estimates

Latent Class 4 -- Adolescents Exposed to Adult Use of All Three Substances

	Grade 9								
Grade 8	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9
LS 1	.574 *.312*	.313 *.688*	.000 *.000*	.000 *.000*	.000 *.000*	.000 *.000*	.000 *.000*	.000 *.000*	.114 *.000*
LS 2	X	.382 *.000*	X	.218 *.000*	.000 .000	.065 *1.00*	.000 *.000*	.219 *.000*	.117 *.000*
LS 3	X	X	.223 *.000*	.192 *.000*	X	X	.201 *.000*	.191 *.509*	.194 *.491*
LS 4	X	X	X	.409 *.000*	X	X	.180 *.000*	.000 *.000*	.411 *1.00*
LS 5	X	X	X	X	1.00 *.249*	.000 *.250*	.000 *.242*	X	.000 *.259*
LS 6	X	X	X	X	.000 *1.00*	.000 *.000*	.000 *.000*	X	1.00 *.000*
LS 7	X	X	X	X	X	X	.000 *1.00*	X	1.00 *.000*
LS 8	X	X	X	.000 *.184*	X	X	.000 *.092*	.199 *.366*	.801 *.357*
LS 9	X	X	X	X	X	X	.000 *.000*	X	1.00 *1.00*

"X" indicates that parameter was set to be equal to 0.
Sample 1
Sample 2

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